

# OPERATING INSTRUCTIONS

BITZER AUSTRALIA

## BITZER CO<sub>2</sub> DX HYBRID PARALLEL COMPRESSOR PLANT

1. General.
2. Safety Instructions.
3. Safety Carbon Dioxide ( R744) CO<sub>2</sub>
4. Inspection and Unit designation.
5. Product/Accessories / Check list.
6. Installation.
7. Application.
8. Operation.
9. Ancillaries/Product Components.
10. Commissioning data.
11. Commissioning Sheet.
12. Service and Maintenance.
13. Drawings.
14. CO<sub>2</sub> Pressure Temperature Chart.
15. CO<sub>2</sub> Operating Window.
16. CO<sub>2</sub> MSDS Sheets.
17. BITZER OIL BSE 60K MSDS Sheets.
18. Risk Assessments.

### 1. General

This document is designed to outline the installation requirements, commissioning & operating instructions for the successful operation of the BITZER Sub-Critical CO<sub>2</sub> DX Hybrid Parallel Compressor Rack.

- BITZER Designed and Engineered.
- Sub-Critical CO<sub>2</sub> Applications only.
- DX [Direct Expansion CO<sub>2</sub> Evaporators Systems only.] Not suitable for Flooded Evaporator Liquid Recirculation Cooling.
- Hybrid system of mixed origins R744 CO<sub>2</sub> Low stage and R134a High stage
- Parallel Compressors available in 2, 3 & 4 Compressor line ups, employing the latest BITZER CO<sub>2</sub> sub-critical SL series compressors.
- Rack Industry title for multiple refrigeration compressor units.

**NOTE: The safety switches, controls, system control valves & electronic controls are not factory set due to the flexible applications of this unit. All controls must be correctly commissioned by a qualified & trained technician.**



## 2. Safety Instructions.

All work on compressors and refrigeration systems shall be carried out only by refrigeration personnel who have been trained and instructed in all work. The qualification and expert knowledge of the refrigeration personnel corresponds to respectively valid guidelines.

All plumbing work on the [Optional] Hot Water BPHE shall be carried out only by licensed accredited plumbing personnel who have been trained and instructed in all work. The qualification and expert knowledge of the plumbing personnel corresponds to respectively valid guidelines. See 9:10

The BITZER CO<sub>2</sub> Hybrid Rack is constructed according to the state of the art and valid regulations. Particular emphasis has been placed on the users' safety.

Retain these Operating Instructions during the entire lifetime of the BITZER CO<sub>2</sub> Hybrid Rack.

### 2.1 Residual hazards

Certain residual hazards from the BITZER CO<sub>2</sub> Hybrid Rack are unavoidable. All persons working on these units must therefore read these Operating Instructions carefully!

### 2.2 Safety References



#### ATTENTION!

Instructions on preventing possible damage to equipment.



#### CAUTION!

Instructions on preventing minor hazard to persons.



#### WARNING!

Instructions on preventing a possible severe hazard to persons.



#### DANGER!

Instructions on preventing an immediate risk of severe hazard to persons.

### 2.3 General safety references



#### WARNING!

**The BITZER CO<sub>2</sub> Hybrid Rack is under pressure with a holding charge of nitrogen to a pressure of 1000 kPa above atmospheric pressure.** Incorrect handling may cause injury to skin and eyes. Wear safety goggles while working on compressor. Do not open connections before pressure has been released.



#### CAUTION!

During operation surface temperatures exceed 60°C or fall below 0°C. Serious burns and frostbite are possible. Switch off and allow cooling down before working on the compressor and associated pipework.



#### CAUTION!

Compressors contain oil & refrigerant under pressure. Release pressure from both high & low side of compressor before servicing.



#### CAUTION!

Tube brazing & compressor operation can produce hot surfaces. To avoid burns, allow surfaces to cool down before continuing installation or servicing.

### 3 SAFETY CARBON DIOXIDE ( R744)

Carbon dioxide is colourless – odourless gas or cryogenic liquid. The AS1677 Refrigeration standard classifies R744 CO<sub>2</sub> as a A1 group refrigerant.

At low concentrations the gas is odourless: @ higher concentrations it has a sharp acidic odour. Carbon dioxide is a powerful cerebral dilator: It is also an asphyxiate and an irritant. The effects and there concentrations of CO<sub>2</sub> refrigerant are listed below in Table 1.

**Table 1 Physiological Effects of CO<sub>2</sub>**

PPM	EFFECTS ON HEALTH
350	Normal value in atmosphere
1,000	Recommended not to be exceeded for human comfort
5,000	Threshold Limit Value (TLV) - Time Weighted Average (TWA) Concentration to which one may be repeatedly exposed for 8 hours per day without adverse effects
20,000	Can affect the respiration function and case exitation followed by depression of the central nervous system plus a 50% increase in breathing rate
30,000	100% increase in breathing rate after Short Term Exposure Limit (STEL) 15 minutes TWA exposure should not exceed at any time of day
40,000 50,000	Immediately Dangerous to Life or Health (IDLH) maximum level
100,000	Lowest lethal concentration. Few minutes exposure produces unconsciousness
200,000	Death accidents have been reported
300,000	Quickly results in unconsciousness and convulsions



#### CAUTION!

Contact with CO<sub>2</sub> cold gas or liquid can cause freezing to exposed tissue, Note: Do not attempt to remove clothing which has stuck to the skin. Burns must be treated by a physician.



#### CAUTION!

Contact with eyes, immediately wash out with plenty of water for several minutes – Obtain medical attention.



#### CAUTION!

Moisture with the air can lead to the formation of carbonic acid that can irritate the eyes. All forms of CO<sub>2</sub> (carbon dioxide) are non-combustible.



#### CAUTION!

Ingestion is not regarded as potential route of exposure, give 200 – 300 millilitres (half pint) of water to drink. Never give anything by mouth to an unconscious person. Do not induce vomiting. Seek immediate medical attention.

#### 3.1 CO<sub>2</sub> Refrigerant detection / Oxygen deprivation detectors:

Ensure that the plant room/s other confined spaces (Coolrooms) are fitted with CO<sub>2</sub> detection sensors (systems) or oxygen deprivation sensor/s. Also refer AS1677 [Accumulation of heavier than air refrigerants.] and [Safety provisions for personnel in refrigerated spaces.]

**Ensure that the plant room has adequate ventilation at all times.**

### 3.2 CO<sub>2</sub> Refrigerant physical properties:

Carbon dioxide CO<sub>2</sub> is heavier than air and should not be allowed to accumulate in low lying areas. Ensure that the current Material Safety Data Sheets for carbon dioxide CO<sub>2</sub> are on site.

[See MSD attached]

Melting point -56.6 °C  
 Boiling point -78.5 °C  
 Density 1.977kg /m<sup>3</sup>  
 Freezing point -56.6 °C  
 Vapour Density 1.53 (air is 1)  
 Vapour pressure @ 15 °C = 5105 kPa  
 Soluble in water, ethanol & acetone  
 Slightly acidic

### 3.3 CO<sub>2</sub> Refrigerant Handling and Storage:

- Use only in well ventilated areas
- Storage: Keep in a cool dry, well ventilated place. Do not store above 45°C

### 3.4 CO<sub>2</sub> Refrigerant Accidental release measures:

- Personal precautions
- Shut off source of leak if safe to do so
- In poorly ventilated areas or confined spaces, use airline respirator or approved self-contained breathing apparatus
- Wear approved safety boots and gloves

### 3.5 Environmental precautions

- Refer to special instructions within safety data sheets
- Clean up actions
- Shut off source of leak, if safe to do so
- Allow product to evaporate
- Ventilate area

Table 2 shows **HAZCHEM** ratings for all commonly used refrigerants: The HAZCHEM code provides advisory information for the emergency service personnel to enable them to take appropriate action in the event of an accident. It can be seen that R744, CO<sub>2</sub> has the same HAZCHEM rating as all other commonly used refrigerants. That is to say that in the event of a major leak of CO<sub>2</sub> the emergency services would respond in the same manner as with any of the other commonly used refrigerants.

**Table 2 - HAZCHEM Rating of Refrigerants**

Refrigerant	Description	HAZCHEM	Boiling Point	ASHREA Safety Code	Hazard	TLV / TWA ppm
<b>R744</b>	CO <sub>2</sub> Carbon Dioxide	2RE	-78.5°C	A1	Asphixiate	5000
<b>R410A</b>	R32 (50%) + R125 (50%)	2RE	-52.2°C	A1	Asphixiate in high concentrations	1000
<b>R404A</b>	R125 (44%) + R123a (52%) + R134a (4%)	2RE	-46.8°C	A1	Asphixiate in high concentrations	1000
<b>R507</b>	R125 (50%) + R143a (50%)	2RE	-46.7°C	A1	Asphixiate in high concentrations	1000
<b>R407C</b>	R32 (23%) + R125 (25%) + R134a (53%)	2RE	-43°C	A1	Asphixiate in high concentrations	1000
<b>R22</b>	Chlorodifluoromethane	2RE	-40.7°C	A1	Asphixiate in high concentrations	1000
<b>R134a</b>	1, 1, 1, 2 - Tetrafluoroethane	2RE	-26.2°C	A1	Asphixiate in high concentrations	1000
<b>R717</b>	NH <sub>3</sub>	2RE	-33.4°C	B2	TOXIC by inhalation	25

The code can be broken down to:

- The number **2** represents the category of gas, Class **2** being nontoxic.
- The letter **R** indicates that a water fog or fine mist sprays used by emergency services to contain a spill or major gas leak.
- The letter **E** indicates the possibility of evacuation.

## 4 Inspection and Designation.

### On receiving your BITZER CO<sub>2</sub> DX Rack:

1. Immediately upon receiving the BITZER CO<sub>2</sub> DX Hybrid [Parallel Compressor] Rack, please inspect the crating, packaging and the BITZER Rack for possible damage during shipment. The crating and packaging has been designed to provide the safest possible protection for equipment transport. **IMPORTANT:** Contact BITZER Australia immediately to notify of any damage reported.
2. Check the BITZER picking slip/list (bill of goods) and product/s provided are correct to your purchase order. (Check unit/s nameplate/s and record serial number/s).
3. Accessories are packaged in separate carton/s. *See Check list section 5.*
4. Check compressor nameplate to ensure you have the correct model and voltage for the application. Also ensure that the maximum pressure/temperature ratings listed on the nameplate are not exceeded during installation or operation.
5. **Before attempting to install rack, be sure to review this document in its entirety.**
6. Ensure that all work carried out on the unit is done by qualified refrigeration personnel, who are suitably trained & instructed. Applicable safety procedures & practices should be followed.
7. The unit is supplied under pressure approximately **1000kPa** above atmospheric pressure. Failure to relieve the holding charge in the correct manner may result in injury.
8. Safety glasses, safety footwear, safety gloves and appropriate work wear must be worn when working on the unit.
9. When receiving multiple BITZER CO<sub>2</sub> DX racks check and insure that the correct rack is located on the nominated system platform / designated area.
10. Install the supplied loose crankcase heaters to each of the compressors.
11. **Do not apply any power supply to the compressor/s unless all suction & discharge shut off service valves are opened. [Fully back seated position]**
12. **Do not operate compressor/s system until in-line valves, controls are set for operation.**
13. **Do not operate compressor/s unless the crankcase heater/s are installed**
14. **Do not operate compressor/s unless compressors are correctly charged with BITER BSE60K oil.**
15. **Do not operate compressor/s unless system is pre-charged with R744 CO<sub>2</sub> Refrigerant.**
16. **Do not operate compressor/s unless High Stage system has been commissioned and is fully functional.**
17. Do not operate or provide any electrical power to the compressor unless the terminal box cover is in place and secured. Measurement of amps and voltage during running conditions must be taken at other points in the power supply.
18. Do not remove terminal box cover until all electrical sources have been disconnected.
19. Follow recommended safety precautions listed on the terminal box cover label before attempting any service work on the compressor.
20. During operation surface temperatures can exceed +60°C. Severe burns are possible.

## **5 Product/Accessories/Check List.**

### **Component Check list for 2 Compressor CO<sub>2</sub> DX Rack**

- 1 x BITZER CO<sub>2</sub> DX Twin Compressor Parallel Rack.
- 2 x BITZER Compressor instructions c/w spare service valve gaskets for compressors.
- 1 x Wooden packing crate.
- 2 x Crankcase heaters [Supplied loose]
- 6 x One Litre cans of BSE60K BITZER Compressor Refrigeration Oil. [Item No. I06-033]
- 6 x Embelton NR3 Equipment Mounting feet each 500kg Rated. [Item No. P37-053]
- 2 x Traxon Oil level Control electrical leads.
- 1 x Suction Drier felt Element F48
- 2 x Liquid line Drier Cores 48-DM. 100% Molecular sieve [Item No. S03-033]
- 1 x Henry Optical level Switch E-9224A N.C. 24V AC/DC [Item No. K06-003] to suit Liquid Receiver bottom Sight Glass.
- 2 x Henry Frost Shield [Perspex viewing elements] to suit Liquid Receiver Top and middle Sight Glasses.
- 1 x spare Temprite coalescent Oil Cartridge sized to application [when Temprite Oil Separator selected]

### **Component Check list for 3 Compressor CO<sub>2</sub> DX Rack**

- 1 x BITZER CO<sub>2</sub> DX Three Compressor Parallel Rack.
- 3 x BITZER Compressor instructions c/w spare service valve gaskets for compressors.
- 1 x Wooden packing crate.
- 3 x Crankcase heaters [Supplied loose]
- 9 x One Litre cans of BSE60K BITZER Compressor Refrigeration Oil. [Item No. I06-033]
- 6 x Embelton NR3 Equipment Mounting feet each 500kg Rated. [Item No. P37-053]
- 3 x Traxon Oil level Control electrical leads.
- 1 x Suction Drier felt Element F48
- 2 x Liquid line Drier Cores 48-DM. 100% Molecular sieve [Item No. S03-033]
- 1 x Henry Optical level Switch E-9224A N.C. 24V AC/DC [Item No. K06-003] to suit Liquid Receiver bottom Sight Glass.
- 2 x Henry Frost Shield [Perspex viewing elements] to suit Liquid Receiver Top and middle Sight Glasses.
- 1 x spare Temprite coalescent Oil Cartridge sized to application [when Temprite Oil Separator selected]

### **Component Check list for 4 Compressor CO<sub>2</sub> DX Rack**

- 1 x BITZER CO<sub>2</sub> DX Four Compressor Parallel Rack.
- 4 x BITZER Compressor instructions c/w spare service valve gaskets for compressors.
- 1 x Wooden packing crate.
- 4 x Crankcase heaters [Supplied loose]
- 12 x One Litre cans of BSE60K BITZER Compressor Refrigeration Oil. [Item No. I06-033]
- 6 x Embelton NR3 Equipment Mounting feet each 500kg Rated. [Item No. P37-053]
- 4 x Traxon Oil level Control electrical leads.
- 1 x Suction Drier felt Element F48
- 2 x Liquid line Drier Cores 48-DM. 100% Molecular sieve [Item No. S03-033]
- 1 x Henry Optical level Switch E-9224A N.C. 24V AC/DC [Item No. K06-003] to suit Liquid Receiver bottom Sight Glass.
- 2 x Henry Frost Shield [Perspex viewing elements.] to suit Liquid Receiver Top and middle Sight Glasses.
- 1 x spare Temprite coalescent Oil Cartridge sized to application [when Temprite Oil Separator selected]

## 6 Installation.

BITZER Sub-Critical CO<sub>2</sub> DX Hybrid racks are designed exclusively for indoor use, preferably within a designated plant equipment room. Refer enclosed safety data, especially 3.1 and Risk assessment documentation prior to any equipment unloading from transport, lifting, and installation.



**WARNING! Careful considerations to lifting should be applied, prior to removal from transporter.**

Instructions:

1. The BITZER CO<sub>2</sub> Rack should only be lifted from the base.
2. The BITZER CO<sub>2</sub> Rack should remain within its wooden crate until, located on designated area within plant room.
3. The BITZER CO<sub>2</sub> Rack must remain perpendicular [upright] and level during installation.
4. A single BITZER CO<sub>2</sub> Rack unit will have a Net Weight between 1250kg up to 2100kg depending on Number of Compressors, Compressors models, BPHE's and options applied.
5. The BITZER CO<sub>2</sub> Rack must be set on a flat level foundation.
6. The designated plant room floor area, must allow for the rack weight and size, Including the Refrigerant weight, Electrical wiring / Equipment, and conform to current building codes.
7. Clearances: A safe working space surrounding 360° to be provided, including free access to above and must conform to current building codes. A safe working distance must also apply to any adjacent switchboards or mains boards.
8. Free working space is required for service of the BITZER DX CO<sub>2</sub> Hybrid Rack.
9. When the BITZER DX CO<sub>2</sub> Hybrid Rack is located in its designated location. Unpack the wooden crate/ Plastic wrapping; Install the Embelton mounting feet to both the floor and the unit frame. Adjust mounting feet until the rack is level.

**Embelton NR3 adjustable mounting foot. Capacity 500Kg each. [Item No. P37-053]**



10. The Embelton mounting feet slightly raise the BITZER DX CO<sub>2</sub> Hybrid Rack off the floor allowing free space for a metal condensate / oil tray to be inserted at floor level. [Recommended]
11. **Ensure that fully operational [tested/certified] CO<sub>2</sub> Refrigerant detection / Oxygen deprivation detectors: Are installed prior to receiving any R744 CO<sub>2</sub> refrigerant to site.**
12. The equipment plant room should be free of dust before the BITZER DX CO<sub>2</sub> Hybrid Rack is connected to any field piping to ensure internal cleanliness.
13. Ensure that the system nitrogen holding charge is expelled from the BITZER DX CO<sub>2</sub> Hybrid Rack, prior to any attempts at connecting field piping.
14. Ensure that the BITZER DX CO<sub>2</sub> Hybrid Rack and all refrigeration field piping are not exposed to atmosphere for any long periods.
15. The System (field) piping must be to AS1677. An inert gas [Dry Nitrogen] must be charged through field refrigeration pipe work during the brazing process. It is recommended that the inert gas be delivered into the pipework, so that air is not also introduced.



## 7 Application.

BITZER Sub-Critical CO<sub>2</sub> DX Hybrid Racks are designed exclusively for the use of Carbon Dioxide (R744) as the low stage refrigerant and R134a as the high stage refrigerant, in a two stage, Cascade system, where the R744 CO<sub>2</sub> systems, evaporators are of direct expansion design.

They are designed to be applied in Low Temperature refrigeration applications & ideal for medium to large supermarkets, Industrial processes, and Frozen Food Storage Rooms.

### ATTENTION!

**BITZER CO<sub>2</sub> Hybrid Racks are exclusively intended for the use in low temperature sub-critical cascade applications. This documentation applies to BITZER DX CO<sub>2</sub> Parallel Hybrid Racks Series only.**

The BITZER CO<sub>2</sub> Hybrid series are a factory assembled range of highly efficient and reliable multiple compressor refrigeration racks, designed with all piping, ready for onsite connection, including all required components (excludes R134a EEV's), controls, transducers and safety devices.

The BITZER CO<sub>2</sub> Hybrid rack is designed with simplicity and serviceability in mind. Figure.1 shows a system schematic outlining the design and refrigerant flow. Details of specific component operation are outlined in section 6.

The BITZER CO<sub>2</sub> Hybrid racks are individually fabricated to each particular, specific application.

The BITZER CO<sub>2</sub> Hybrid racks comprise of:

- 1 x BITZER Designed / Engineered Structural Steel Unit frame Assembly.
- 1 x BITZER Compressor Mount cradle.
- 2-4 BITZER SL Series CO<sub>2</sub> Compressors.
- 2-4 Stainless Steel Suction Lines [from 1-Core Suction Drier / Accumulator Vessel to each Compressor]
- 1 x BITZER 1-Core Drier Shell / Accumulator Metal Clad and Insulated Vessel.
- 2-4 Steel Discharge Branches,
- 1 x Steel Discharge manifold and steel discharge pipe to oil separator.
- 1 x Oil Separator/Reservoir sized to application. [Optional: BITZER COS or Temprite Coalescent Oil Separator / Reservoir]
- Two in parallel BPHE Cascade Condensers c/w Metal Cladding and 75mm Insulation. Engineered to application and clients Specifications. [BPHE's CO<sub>2</sub> Condenser side and R134a Evaporator side]
- 1 x Suction Re-Heat BPHE c/w Metal Cladding and Insulation. Engineered to application.
- 1xEmergencyCoolingBPHECascadeCondenser/EvaporatorR744/R134a comes with R134a Tx Valve. To maintain refrigerant CO<sub>2</sub> temperature/pressure within the Liquid Receiver during IE: catastrophic system failure / power failure.
- 1 x Horizontal liquid Receiver c/w Level Indicator Sight glasses, engineered to application.
- 1 x BITZER Dual Suction/Liquid header Assembly c/w Insulated PVC Enclosure, Suction ball Valves/service valves, Liquid ball valves.
- 1 x Liquid line 2-Core Drier Assembly c/w c/w Insulated PVC Enclosure, Liquid Line By-Pass circuit for continuous run during drier replacement and one Ø3/8" MSAE post service valve for system charging or refrigerant reclaim prior to Drier core replacement.
- Compressor pressure controls 1 x LP and 1 x HP per compressor.
- System Pressure Controls (5.) comprising of 1 x LP and 4 x HP controls.
- BITZER Pressure Relief Manifold consisting of 1 x LP Pressure Relief Valve 2500kPa, 6 x HP Pressure Relief Valves 4000kPa, 1 x LP Bleed Solenoid, 1 x HP Bleed Solenoid, associated Service valves, 1 x LP transducer port c/w service valve and 1 x HP transducer port c/w service valve.
- System interconnecting refrigeration pipe work engineered to application and safe working pressure specifications.
- System interconnecting flexible hoses engineered to application and safe working pressure specifications.
- All Refrigeration Ball Valves, Packed Capped Valves, Rotolock Valves, Check Valves, inline products, Copper Tubing, Copper Fittings, Brass Fittings, Flexible Lines are safe working pressure rated at greater than 2500kPa low side and greater than 4500kPa High side.



## 8 Operation.

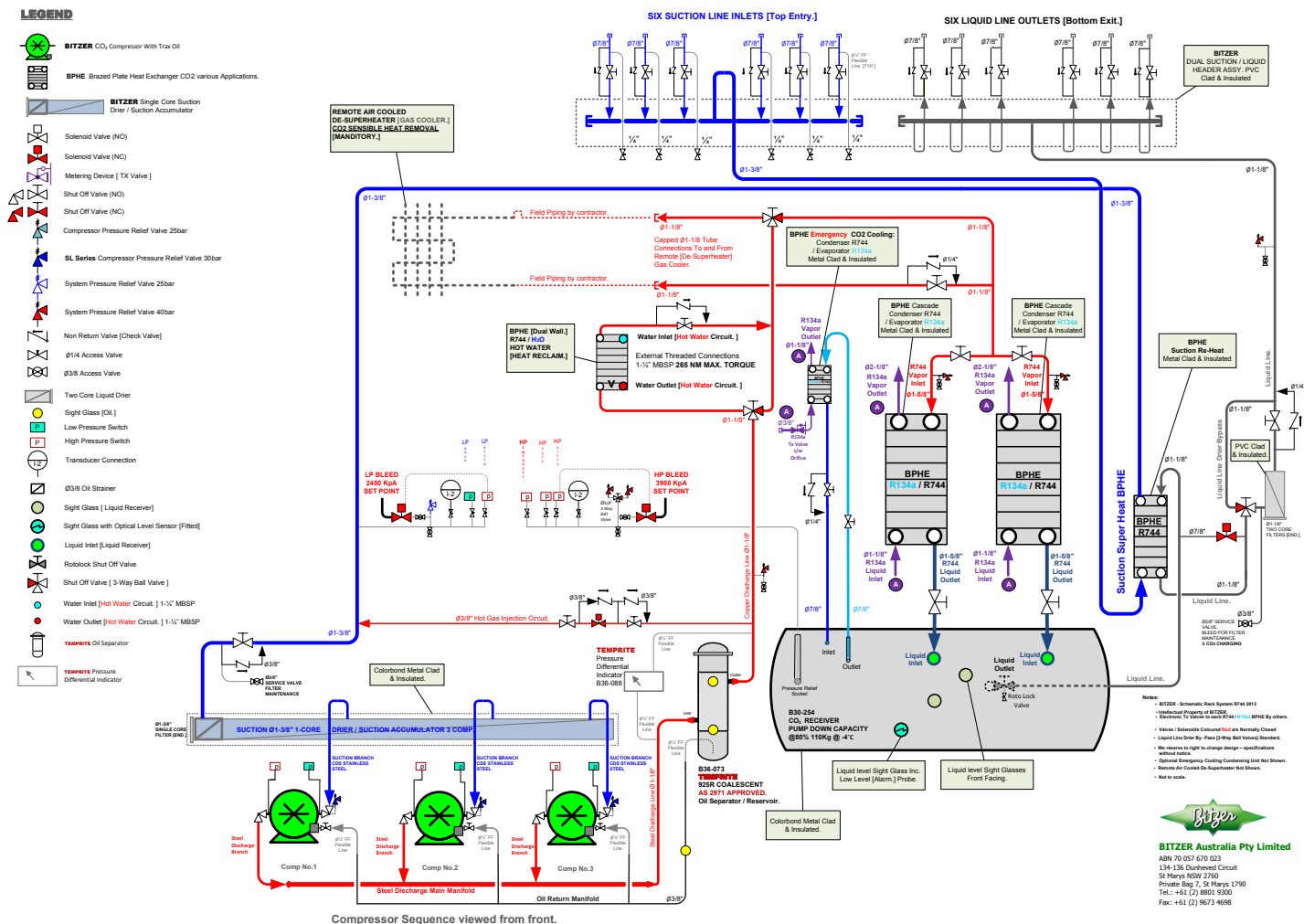
### The BITZER DX CO<sub>2</sub> Hybrid racks

- The High pressure liquid CO<sub>2</sub> leaves the Liquid Receiver via the insulated liquid line. This liquid enters a CO<sub>2</sub> liquid/CO<sub>2</sub> suction vapour Braze Plate Heat Exchanger (BPHE). The purpose of this heat exchanger is to add additional superheat to the suction return vapour. This ensures that the oil in the compressor crankcase is sufficiently warm to avoid catastrophic compressor failure. An additional hot gas injection is installed into the suction line to ensure sufficient superheat. This design also provides simultaneous sub cooling to the liquid supply to the evaporators.
- There is a liquid line by-pass circuit complete with inline (NC) solenoid valve, prior to the (BPHE) this solenoid when open causes the liquid refrigerant to partially by-pass the (BPHE) reducing the amount of superheat of the return suction CO<sub>2</sub>. The Liquid CO<sub>2</sub> leaves the BPHE via a three way ball valve then on to the 2-core [100% molecular sieve] drier shell. There is also a drier shell by-pass circuit to simplify drier core changeover, while the system remains in operation. The by-pass is operated by the liquid line three way ball valve and straight thru ball valve. We have also provided a Ø3/8" post valve for liquid charging, fast evacuation or reclaiming refrigerant from the drier cavity prior to drier core replacement. The liquid refrigerant exiting the liquid line then enters the four, six or eight circuit liquid header [manifold]. The sub cooled liquid then enters field piping to the LT evaporators via electronic expansion valves [located at fixtures] and returns to the rack as superheated vapour via the four, six or eight circuit suction (return) header (manifold).
- The suction vapour then flows within the suction line to the CO<sub>2</sub> suction vapour (BPHE) gaining superheat. The suction return vapour then enters the suction filter/ accumulator vessel, before reaching the compressors.
- The low pressure suction vapour then enters the compressor/s where it becomes compressed to a high superheated pressure then discharged into a common header before it enters the Oil Separator/Reservoir. The Oil is separated/filtered and returned back to the compressor/s via an oil manifold.
- Individual oil levels within each compressor are maintained with TRAX oil controls fitted to the crankcase of each compressor.
- The high pressure discharge vapour once leaving the oil separator can be directed to the (Optional) dual wall Hot Water BPHE or directly to the integral or remote Air Cooled De-Superheater. The BITZER Air cooled De-Superheater reduces the discharge gas temperature to an acceptable level where the vapour can be permitted to enter the matched parallel set of BPHE Cascade Condensers/Evaporators.
- The matched set [two in parallel] CO<sub>2</sub>/R134a BPHE Condensers / Evaporators, remove the CO<sub>2</sub> THR (total heat of rejection) and condense the CO<sub>2</sub> back into liquid state. Condensing is achieved by the counter flow of R134a liquid refrigerant evaporating from the high stage of the Cascade system. The liquid CO<sub>2</sub> then drains into the insulated horizontal Liquid Receiver where the whole process continues.

#### NOTES:

- The Air Cooled De-Superheater is mandatory requirement on all BITZER DX CO<sub>2</sub> systems. The Air Cooled De-Superheater provides improved efficiency, reliability and ensures that the BPHE's Cascade Condensers/Evaporators are within their small operating envelope.
- Operating a BITZER DX CO<sub>2</sub> rack without an Air Cooled De-Superheater voids all warranty.
- The Air Cooled De-Superheater should be set to maintain a CO<sub>2</sub> outlet temperature of less than 60kTD above the R134a Evaporation temperature.

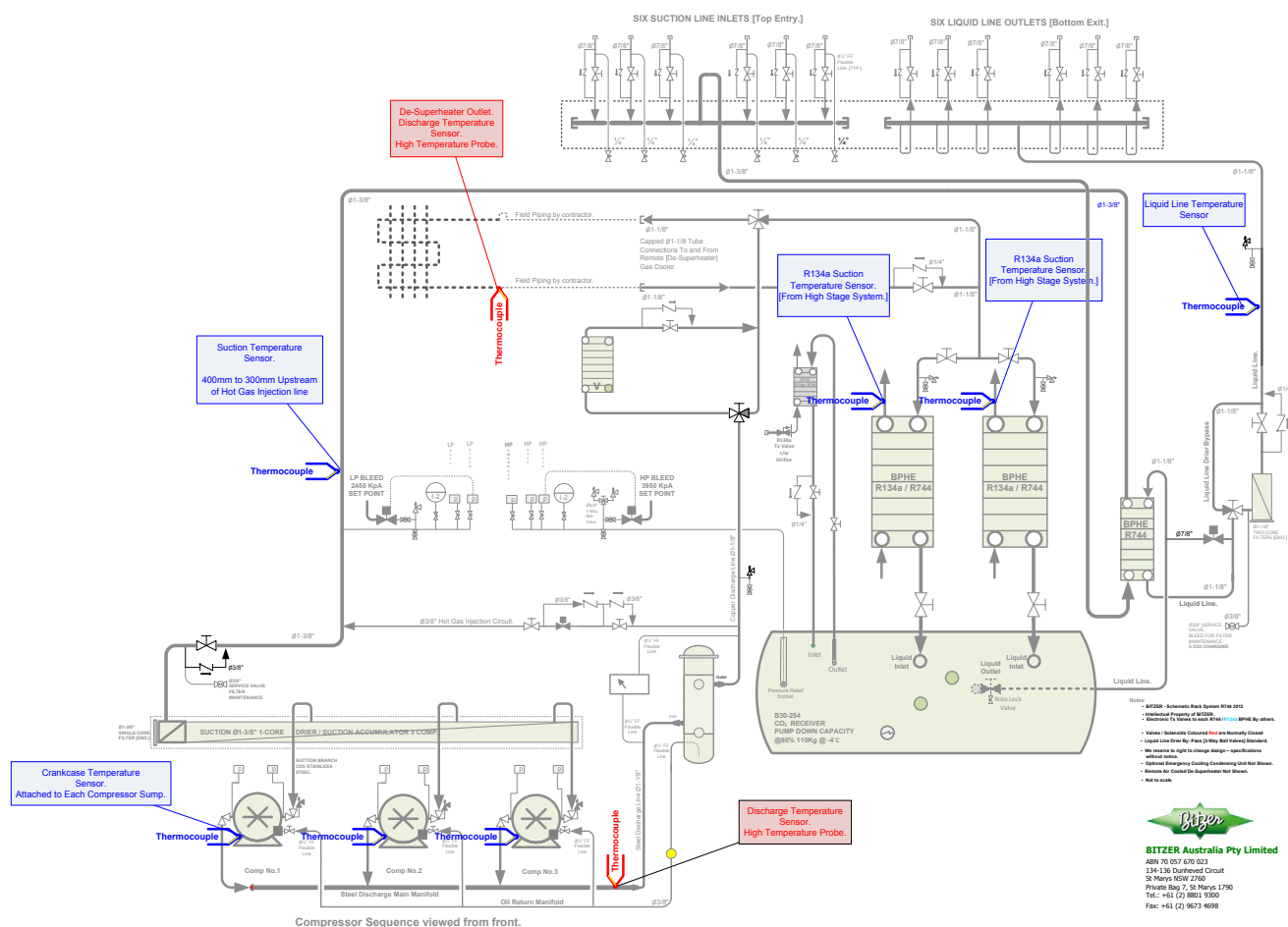
**Figure 1 - BITZER CO<sub>2</sub> Hybrid Rack Schematic .**



**NOTES:**

- Schematic depicting 3- Compressor DX CO<sub>2</sub> Rack
- Schematic depicting system complete with Temprite Oil Separator/Reservoir and Pressure Differential Indicator
- Schematic depicting system complete with Hot Water BPHE
- Remote Air Cooled De-Superheater depicted with dotted lines. (Integral Air Cooled De-Superheater Option not shown)
- Remote or integral Air Cooled Condensing Unit for Emergency Cooling BPHE option not shown

**Figure 1A - Thermocouple probe Locations BITZER CO<sub>2</sub> Hybrid Rack Schematic .**



**NOTES:**

- Schematic depicting 3- Compressor DX CO<sub>2</sub> Rack with recommended Thermocouple Probe locations
- Additional Probe locations
- The CO<sub>2</sub> Suction Line outlet of Suction Re-Heat BPHE
- The Discharge line before the cascade condenser BPHE's
- Both Liquid CO<sub>2</sub> Outlets of cascade condenser BPHE's before Liquid Receiver

## 9. Ancillaries /Compressors

At the heart of the BITZER CO<sub>2</sub> Hybrid Rack is the BITZER Octagon CO<sub>2</sub> compressor, the solid drive gear design and valve plate construction have been specifically adapted to the requirements of CO<sub>2</sub> which leads to a further increase in operational efficiency.

### BITZER SL Series sub-critical CO<sub>2</sub> Compressor.



#### Maximum Permissible Pressure (standstill)

Suction side: SL Models **30 Bar.**

HC Models: **25 Bar.**

Discharge side: SL Models **53 Bar.**

HC Models: **43 Bar.**

#### Minimum Suction Gas Superheat:

20K, lower suction gas superheat is possible provided that the minimum oil and discharge gas temperatures are maintained.

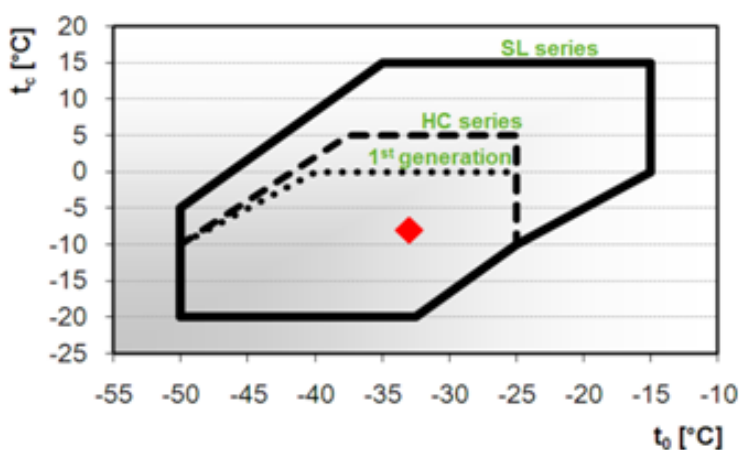
#### Minimum Oil Temperature:

20°C (for continuous operation oil temp should not fall below 30°C).

#### Minimum Discharge Temperature:

40°C (for continuous operation discharge temp should not fall below 50°C).

### Operating Envelope BITZER CO<sub>2</sub> Sub Critical Compressors.



#### Note:

- SL Series Latest Generation.
- HC Series Previous Generation still current.
- 1st Generation.

## 9. Ancillaries /Compressors BITZER CO<sub>2</sub> Sub-Critical Compressors

### The BITZER CO<sub>2</sub> Hybrid SL Series Compressors

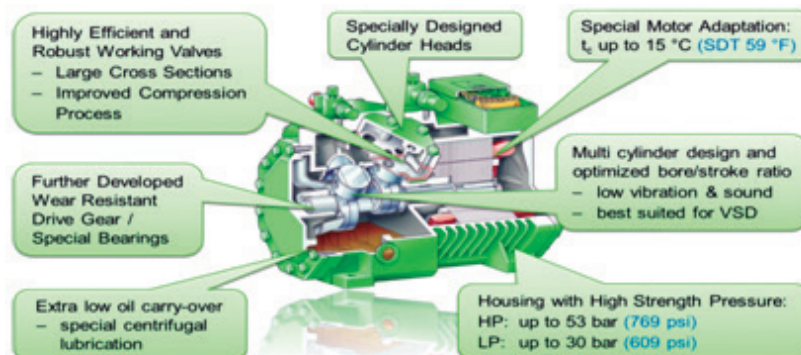


Table 3 - BITZER Compressor Technical data.

Technical Data										Electrical Data			
Item No.	Compressor Type	Displacement with 1450 min-1 m3/Hour	Number of Cylinders	Oil Charge dm3 ①	Weight Kg	Pipe Connection DL Discharge Line		Pipe Connection DL Suction Line		Motor Connection Volt ②	Max. Operating Current. Amp. ③	Max. Power Consumption kW ③	Starting Current (Locked Rotor.) Amp. ③
						mm	Inch.	mm	Inch.				
J04-469	<b>2MSL-07K</b>	1.73	2	1.0	47	12	½"	16	¾"	$\Delta / Y$ 220..240V $\Delta$ -3 - 50Hz, 380..420V $Y$ -3 - 50Hz 265..290V $\Delta$ -3 - 60Hz, 440..480V $Y$ -3 - 50Hz	4.5/2.5	1.1	25.6/14.8
J04-490	<b>2KSL-1K</b>	2.71	2	1.0	47	12	½"	16	¾"		6.1/3.5	1.8	39.0/22.5
J04-491	<b>2HSL-3K</b>	4.34	2	1.0	50	12	½"	16	¾"		10.7/6.0	3	44.2/25.5
J04-492	<b>2FLS-4K</b>	6.36	2	1.0	53	12	½"	16	¾"		15.4/8.6	4.6	68.1/39.3
J04-493	<b>2DSL-5K</b>	9.23	2	1.5	77.5	16	¾"	22	¾"		20.1/11.3	6.4	107.7/62.2
J04-494	<b>2CSL-6K</b>	11.20	2	1.5	94	16	¾"	22	¾"		24.8/13.9	7.8	107.7/62.2
J04-495	<b>4DSL-10K</b>	18.45	4	2.0	94.5	22	¾"	28	1-¼"		39.3/22.0	12.7	168/97

#### Crankcase Heater

☐ 230V

- 2MSL-07K..2FSL-4K: 0..60W  
Self regulating PTC Heater
- 2ESL-4K..4CSL-12K: 0..120W  
Self regulating PTC Heater
- 4VSL-15K..4NSL-30K: 0..140W  
Self regulating PTC Heater



Crankcase heater is generally required  
due to high solubility of CO<sub>2</sub> in the oil

#### Explanations

- ① BSE60K: Oil Standard applications  
BSE85K: Oil Booster applications and applications with high discharge gas temperatures
- ② Tolerance (+or- 10%) based on mean value of voltage range.  
Other voltages and electrical supplies on request.
- ③ For the selection of contacts, cables and fuse the max.  
Working current / max. power consumption must be considered. See also ④
- ④ Data for compressors with voltage 380V.. 420V (220.. 240V) are based on average voltage of 400V (230V)

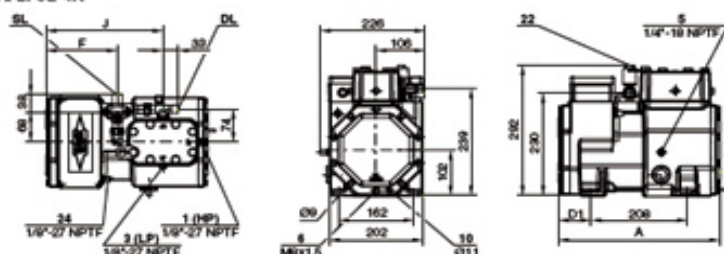
#### Conversion factors:

380V (220V) 0.95  
420V (240V) 1.05

## 9. Ancillaries /Compressors: Crankcase Heaters.

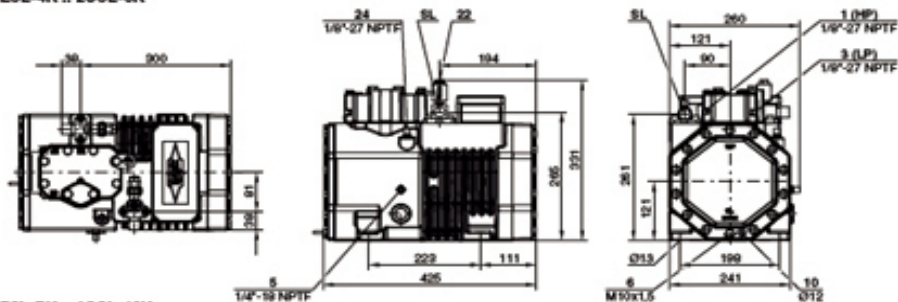
Figure 2.0 - Dimensional Drawings:

2MSL-07K .. 2FSL-4K

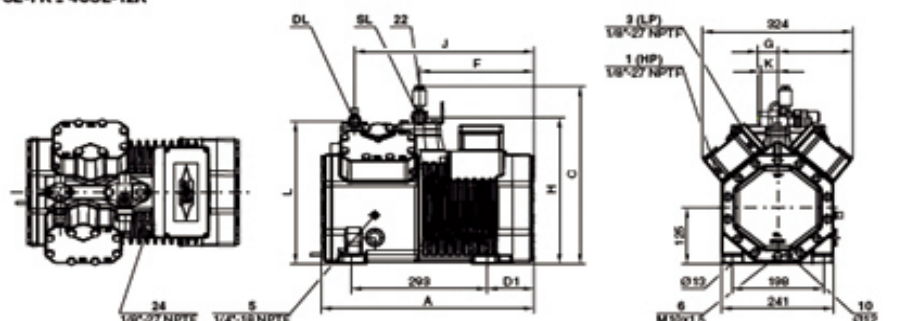


Verdichtertyp Compressor type	A	D1	F	J
Type de compresseur	mm	mm	mm	mm
2MSL-07K .. 2MSL-3K	349	70	153	252
2GSL-3K & 2FSL-4K	374	95	178	277

2ESL-4K .. 2CSL-6K



4FSL-7K .. 4CSL-12K



Verdichtertyp Compressor type	A	C	D1	F	G	H	J	K	L
Type de compresseur	mm	mm	mm	mm	mm	mm	mm	mm	mm
4FSL-7K	459	397	101	247	42	327	387	38	318
4ESL-9K	459	400	101	247	57	330	387	38	318
4GSL-10K	459	409	101	247	57	330	387	42	322
4CSL-12K	492	409	134	280	57	330	420	42	322

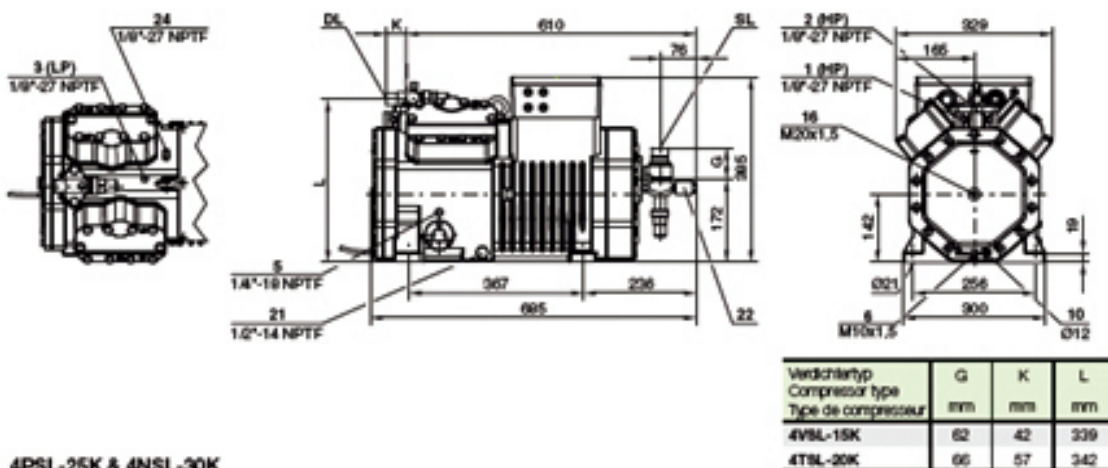
### Connection Positions:

1. High Pressure Connection (HP)
2. Low Pressure Connection (LP)
5. Oil Fill Plug
6. Oil Drain
10. Crankcase Heater
16. Connection for Oil Monitoring (Oil Sensor)
21. Connection for Oil Service Valve
22. External Pressure Relief Valve
24. Service Connection
- SL. Suction Service Valve
- DL. Discharge Service Valve

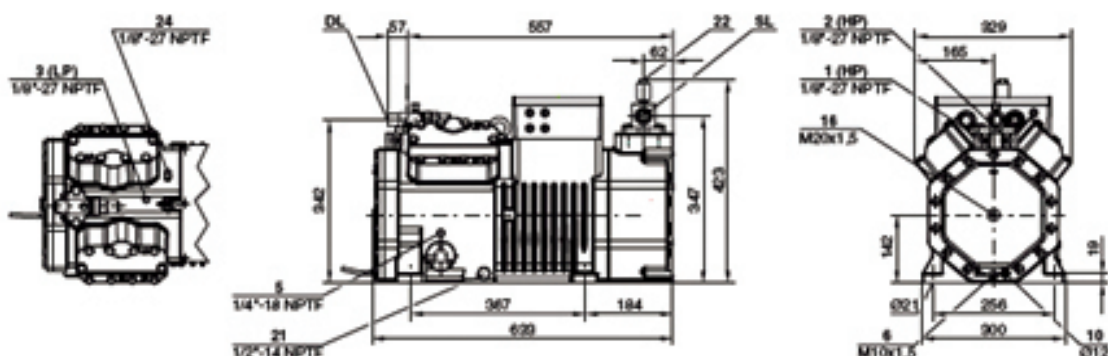


Figure 2.1 - Dimensional Drawings:

**4VSL-15K & 4TSL-20K**



**4PSL-25K & 4NSL-30K**



**Connection Positions:**

1. High Pressure Connection (HP)
2. Low Pressure Connection (LP)
5. Oil Fill Plug
6. Oil Drain
10. Crankcase Heater
16. Connection for Oil Monitoring (Oil Sensor)
21. Connection for Oil Service Valve
22. External Pressure Relief Valve
24. Service Connection
- SL.** Suction Service Valve
- DL.** Discharge Service Valve

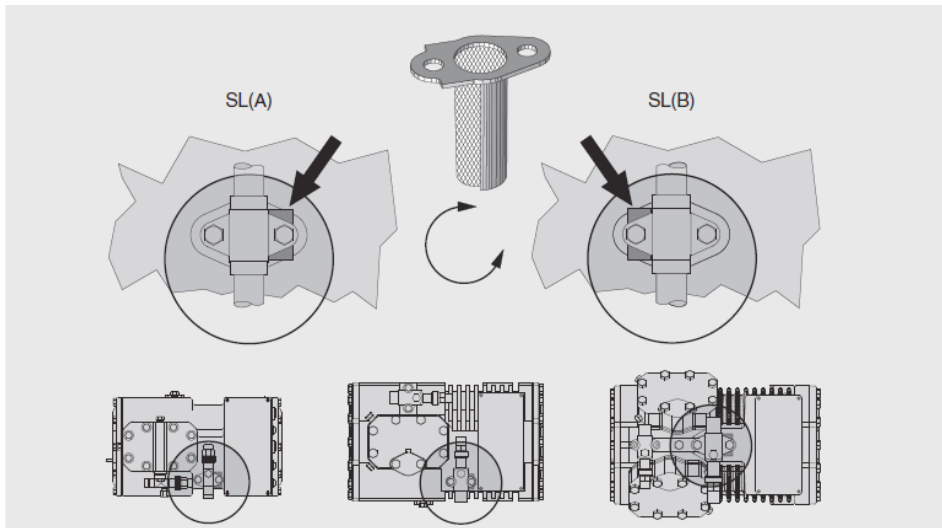


## 9. Ancillaries /Compressors: Suction Filter [within each Compressor]

**BITZER** compressors of the “Octagon” series are designed with a Suction Filter located under the Suction service valve. This filter is easily removed for inspection / cleaning when necessary IE: During oil change.

**SUCTION GAS FILTER SHOULD ALWAYS BE IN SL (A) POSITION ON BITZER CO<sub>2</sub> RACKS**

**Figure 3 - Suction Filter**



For further information refer to document KB100-5 @ [www.bitzer.com.au](http://www.bitzer.com.au)

### 9.2 Ancillaries/ Electrical Connections



**WARNING!**

#### **ELECTRICAL SHOCK HAZARD**

Failure to comply with these safety warnings could result in serious injury or death. All installation and servicing activities should be performed only by trained personnel. Wear safety goggles. Shut off all power to this equipment during installation, service and maintenance. Lock and tag all disconnect locations until work is complete.



**WARNING!**

**All electrical wiring should be carried out by qualified persons and in accordance with AS3000 or equivalent standard in the country of installation.**

**Refer to AS3000 for electrical installation and for service/ maintenance of electrical equipment**

#### 9.2.1 Electrical Connections; Frequency Inverters

BITZER Australia recommends that the lead CO<sub>2</sub> compressor should operate with a frequency inverter in order to reduce compressor cycling. It is also advantages as higher system efficiency can be achieved, especially under partial load.

### 9.2.2 Selection Criteria; Frequency Inverters

The frequency inverter must be able to continuously supply the maximum operating current to the compressor motor additionally, a 10% reserve should be planned for. Selections should be made in accordance with KT-420-1 Application Manual.

The torque of reciprocating compressors is not constant with the angle of rotation, the higher the number of cylinders, the more constant the torque, thus a greater starting torque is required for a smaller number of cylinders.

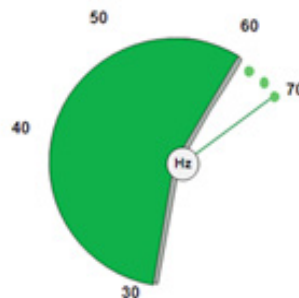
The maximum current must be within the transient overload rating of the frequency inverter. If this is not the case, then a larger type of frequency inverter must be selected.

Several values of rated current (constant and quadratic torque ratings) are provided by frequency inverter manufacturers, select a frequency inverter based on a constant torque rating.

The frequency inverter must be capable of briefly delivering over torque during the starting phase in order to overcome the break-away torque and too accelerate the drive.

This results in increased current demand for starting the compressor, which must be provided for by the frequency inverter in the ramp up time.

- Variable speed drive (VSD)
- Standard speed range:
  - ⇒ HC Series: 30 Hz .. 50 Hz
  - ⇒ SL Series: 30 Hz .. 60 Hz
- Trans-synchronous operation:
  - ⇒ motor reserve limited with R744
  - ⇒ (constant torque requirement)
- For a constant torque above 50 Hz
  - ⇒ VSD with auxiliary transformer (higher output voltage)
  - ⇒ Motor layout 230 V / 3 / 50 Hz



### 9.2.3 Electronic Screening

Use screen cables. Ensure large area contact to the housing of the compressor. The frequency inverter must be fitted with suitable EMC filters, connect both ends of motor cable to the ground.

### 9.2.4 Compressor Contactor

A compressor contactor should always be used to ensure the correct function of the safety circuit.

### 9.2.5 Ramp up time to Minimum Speed

A Ramp up time of between 1-3 seconds to minimum speed, enables a soft start and at the same time adequate lubrication is achieved.

### 9.2.6 Abnormal Vibrations

The pulsation frequency in the discharge line and the excitation frequency at the compressor feet and in the piping system depend on the compressor speed. This can result in resonance effects in pipelines and other plant components. Therefore the entire plant must be carefully checked for abnormal vibration during commissioning and repeatedly during the operation at each frequency.

Frequencies at which resonance occur must be blocked out in the frequency inverter programming.

In certain cases there can be a mismatch in the compressor/frequency inverter selection where the compressor and inverter do not have adequate reserves; this may result in a large number of frequency ranges where resonance occurs.

**PLEASE CONTACT BITZER AUSTRALIA IN SUCH CASES FOR FURTHER ADVICE.**

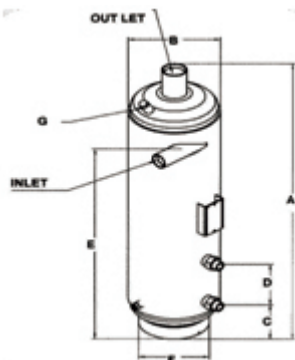
Further information on frequency inverters refer to Document KT420- [www.bitzer.com.au](http://www.bitzer.com.au).

### 9.3 Ancillaries/BITZER COS Oil Separation System.

#### OPTION No. 1#

The BITZER CO<sub>2</sub> DX Hybrid racks come with a high efficiency BITZER COS Oil separator / Reservoir used in conjunction with Traxon oil level controls.

**Figure 4: BITZER COS CO<sub>2</sub> Oil Separator.**



**Oil Separator Technical Data**

The BITZER Centrifugal oil separator provides improved oil separation, very low pressure drops and greatly reduced vibration levels due to the patented centrifugal oil separator cartridge fitted within the top half of the vessel. The lower section contains the oil reservoir with a high and low level sight glass and oil service valve.

The BITZER COS Oil Separator is manufactured to AS1210.

The centrifugal separators are ideally suited to multiple compressor parallel systems, and compressors using capacity control or systems with a wide range of required capacity.

**Table 4 - COS CO<sub>2</sub> Oil Separator Technical Data**

Model Number	BITZER Item No.	inlet size Ø	outlet size Ø	A Height	B Diameter	C Sight glass	D Sight glass	E inlet height	F stand ring
		ID	ID	±5mm	OD	± 5mm	± 5mm	± 5mm	OD
COS 1	B36-063S	Ø1-1/8"	Ø1-3/8"	662mm	Ø168mm	110mm	N/A	515mm	114mm
COS 2	B36-053C	Ø1-3/8"	Ø1-5/8"	870mm	Ø219mm	128mm	140mm	668mm	168mm

G =Safety relief valve socket Ø3/8"BSP. Fastening bolt Ø1/2"BSP. Oil outlet valve Ø3/8"rotalock

**NOTE: Oil Separator is not Pre-charged with Oil.** Please insure that the oil separator is charged with a correct quantity of the nominated oil prior to final evacuation.



**ATTENTION! Only use BITZER BSE 60K POE Oil.**

BITZER Item No.	Model No.	Oil Quantities in Litres	
COS Oil Separator - Reservoir		Oil Level to Centre Line of Lower Sight Glass	Oil Level to Centre Line of Upper Sight Glass
B36-063S	COS 1	1.62	3.29
B36-053C	COS 2	2.92	7.44
Tolerance + or - 50ml			

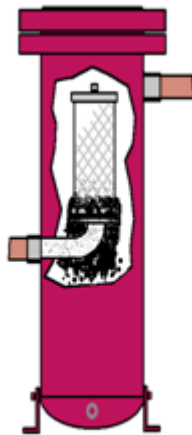
### 9.3 Ancillaries/BITZER Temprite Coalescent Oil Separation System

#### OPTION No. 2#

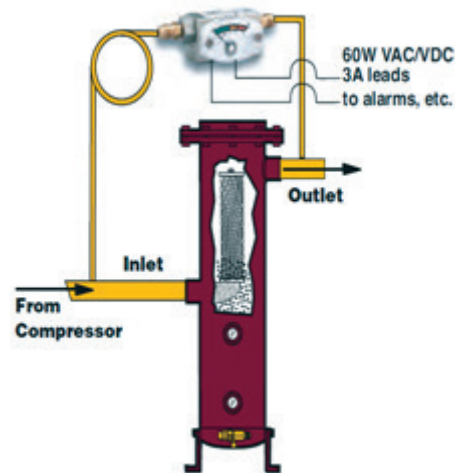
The BITZER CO<sub>2</sub> DX Hybrid racks can offer an option to fit a high efficiency Temprite Coalescent Oil Separator / Reservoir.

- The Temprite Coalescent Oil Separators have an internal filter, installed. Temprite™ Coalescent Oil Filters will pick up all dirt and effluent to 3.0 microns. (Typical Filter driers only catch 50 microns or larger) Replace the coalescent filter if dirt loading is above 0.896 Bar / 89.63kPa./ 13.0 PSI differential across the separator (Refer the Temprite Differential Indicator) See below.
- The Temprite Coalescent Oil Separators are also excellent at maintaining oil cleanliness. (This has a direct positive effect in reducing operational costs)
- The Temprite Coalescent Oil separator / Reservoirs are not affected by velocity and are 98.5% efficient down to 20% of total rated load.

#### Temprite Coalescent Oil separator / Reservoir.



#### Temprite Oil Separator with Pressure differential Indicator. PDI installed



#### Pressure differential Indicator (PDI) - BITZER Item No. B36-088



This PDI indicator includes electrical leads that can be wired to your Micro-processor refrigeration control system to indicate when the differential across the oil separator is too high (requiring a filter change)

### 9.3 Ancillaries/BITZER Temprite Coalescent Oil Separation System

#### Temprite Clean up Filter.



#### Temprite Filter Change Instructions:

1. Isolate Oil separator from System.
2. Recover or recycle any remaining refrigerant from the oil separator.
3. Be sure that the Oil Separator is de-pressurized.
4. Carefully unbolt the flange bolts and nuts. (Put aside with washers to be reused)
5. Carefully remove the top plate.
6. Remove the filter retaining nut and sealing washer.
7. Remove the old filter and "O" ring from the bottom of the filter.
8. Make sure that the filter sealing surface inside the separator is smooth and clean of dirt.
9. Wipe clean oil separator internals so that it is free from any dirt, scale or contaminants.
10. Dispose old oil properly.
11. Install a new Temprite™ replacement filter cartridge.
- a.) Apply a thin film of clean refrigeration oil to the "O" ring of the new filter and insert the new filter into the separator so that it is centred and that the "O" ring seats flush on the sealing surface.
- b.) Re-attach the new sealing washer and filter nut.
- c.) Tighten the filter nut until it will not turn.
- d.) Tighten the filter nut an additional 1/2 to 3/4 turn.
12. Thoroughly remove the old gasket or "O" ring from the groove. (Careful not to scratch the steel surface)
13. For 930R select the correct "O" ring and fit in the groove, discard extra "O" ring.
14. Replace the flange "O" ring or gasket in the groove dry, and then apply oil with 360° coverage of the "O" ring.
15. Pre charge the Oil separator with BSE60K oil. (see nameplate for quantity)
16. Re attach the top cover plate to flange by first finger tightening nuts on bolts with lock washers, in between nut and flange face. Start with any given bolt and gradually tighten crisscross pattern firmly up to 27 to 29.8 N-m of torque for 922R - 9227R. 67.7 to 74.5 N-m of torque for 928R. 94.9 to 101.6 N-m of torque for 930R. Tighten mounting bolts in an opposing pattern to ensure even pulling down of the top cover assembly.
17. Leak test/check the oil separator flange junction.
18. Evacuate the oil separator and interconnecting lines.
19. Return the oil separator to operation, slowly open the isolating valves.
20. Monitor the oil levels and pressure drop frequently.
21. Continue to replace filters until you maintain a pressure drop staying below 0.896 Bar / 89.63kPa./ 13.0PSI differential across the separator. The separator is clean.

#### NOTES:

- The clean-up Oil Filters are for clean-up purposes only. They remove dirt down to 3.0 microns.
- The STD oil filters remove dirt down to 0.3 microns and you will have 98.5% oil separation for normal operation.
- **Oil Separator is not Pre-charged with Oil.** Please ensure that the oil separator is charged with a correct quantity of the nominated oil prior to evacuation.



#### ATTENTION!

Only use BITZER BSE 60K POE Oil.

### 9.3 Ancillaries/BITZER Temprite Coalescent Oil Separation System

#### Temprite AS2971 - Coalescent Oil Separator/Reservoirs models and Accessories:

<b>BITZER Item No.</b>	<b>Description</b>
<b>B36-070</b>	922R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-071</b>	923R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-072</b>	924R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-073</b>	925R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-074</b>	926R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-075</b>	927R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-076</b>	928R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-077</b>	930R OIL SEPARATOR/RESERVOIR COALESCENT c/w Filter kit
<b>B36-078</b>	OIL FILTER KIT STD. 922R/923R
<b>B36-079</b>	OIL FILTER KIT CLEAN-UP. 922R/923R
<b>B36-080</b>	OIL FILTER KIT STD. 924R/925R
<b>B36-081</b>	OIL FILTER KIT CLEAN-UP. 924R/925R
<b>B36-082</b>	OIL FILTER KIT STD. 926R/927R
<b>B36-083</b>	OIL FILTER KIT CLEAN-UP. 926R/927R
<b>B36-084</b>	OIL FILTER KIT STD. 928R
<b>B36-085</b>	OIL FILTER KIT CLEAN-UP 928R
<b>B36-086</b>	OIL FILTER KIT STD. 930R
<b>B36-087</b>	OIL FILTER KIT CLEAN-UP 930R
<b>B36-088</b>	PRESSURE DIFFERENTIAL INDICATOR <b>224#</b>

Temprite Oil Separator/Reservoirs are manufactured to AS2971 with a Design Pressure 45 bar.

#### Temprite Oil Separator/Reservoirs recommended BSE60K vessel oil charge.

<b>BITZER Item No.</b>	<b>Description</b>	<b>Oil Charge Litres</b>
<b>B36-070</b>	922R OIL SEPARATOR/RESERVOIR COALESCENT	2.27
<b>B36-071</b>	923R OIL SEPARATOR/RESERVOIR COALESCENT	2.27
<b>B36-072</b>	924R OIL SEPARATOR/RESERVOIR COALESCENT	3.22
<b>B36-073</b>	925R OIL SEPARATOR/RESERVOIR COALESCENT	3.22
<b>B36-074</b>	926R OIL SEPARATOR/RESERVOIR COALESCENT	6.7
<b>B36-075</b>	927R OIL SEPARATOR/RESERVOIR COALESCENT	6.7
<b>B36-076</b>	928R OIL SEPARATOR/RESERVOIR COALESCENT	7.55
<b>B36-077</b>	930R OIL SEPARATOR/RESERVOIR COALESCENT	21.25

**NOTE:** BITZER COS and Temprite Coalescent Oil Separator / Reservoirs complete with accessories are available from BITZER Price Book.

#### 9.4 Ancillaries/ TRAX Oil. Compressor oil level control.

The OW3 Trax Oil uses a Hall-Sensor to measure oil level. A magnetic float changes its position according to the oil level. The Hall-Sensor converts these magnetic field changes into an equivalent signal, which is used by the electronic controller to show with LED's the actual oil level. If the oil level drops into the red zone the OW3 generates an alarm signal and the alarm contact (SPDT) changes into the alarm state. The later can be used to shut down the compressor. If the oil level comes back to normal the alarm will reset.

The level control is divided into 3 zones. The green LED indicates that the oil level is within the normal limit green zone (50-70% sight glass height) and only the green LED is on. On reaching the yellow zone the OW3 is switching on the yellow LED after a 10 second delay. The time delay of 10sec is necessary to avoid flickering of the LED's during compressor start up as the oil level can vary greatly and thereby switching the LED on/off frequently. When in the yellow zone only the yellow LED is on (50-30% sight glass height). The yellow zone can be interpreted as a warning zone and indicate that the oil separator is not operating correctly or that the compressor is throwing out excessive oil into the system.

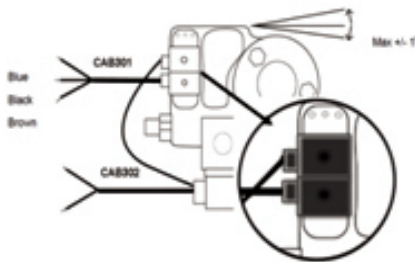
Should the oil level reach the red zone (30% sight glass height) the OW3 will generate a critical alarm after a delay of 20sec. The alarm relay will switch to "ALARM" and the red LED will illuminate.



#### ATTENTION!

**The external compressor control circuit wiring should automatically shut down. The compressor/s failure to do so may result in compressor damage and void warranty.**

**Figure 5 - OW3 Electrical Wiring**



Connect CAB301 cable to relay connection, maximum 3A/240V according to figure 7

- Blue (open in Alarm)
- Black (Common)
- Brown (closed in Alarm)
- Do not switch compressor directly, use the compressor power relay instead.
- Connect CAB302 cable to 24VAC 50/60Hz 0.7A (see Figure 7).
- Ensure the cables are parallel to each other and they protrude out the side and not over the LED's



#### WARNING!

**All electrical wiring should be carried out by qualified persons and in accordance with AS300 or equivalent standard in the country of installation.**

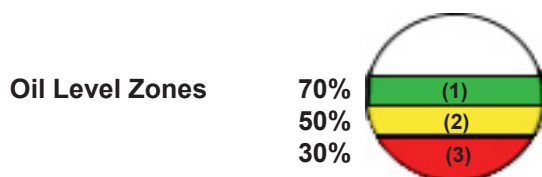


**Figure 6 - OW3 Sight Glass Level Control Zones & Technical Data**

### TR3 Operation

The sight glass is divided into three main zones. When the level reaches the yellow zone (2) the TR3 starts filling after a time delay of 10 seconds. When the level drops to the red zone (3) the control will switch the alarm relay contacts on after a time delay of 20 seconds. The current oil status is indicated with the three LED's according to the following table:

LED	Status/Function
Green	Oil Level zone 1 (70 - 50%)
Yellow	Oil Level zone 2 (50 - 30%) injection
Red Yellow	Oil Level zone 3 (30 - 0%) alarm & injection



### 9.5 Ancillaries/CO<sub>2</sub> Brazed Plate Heat Exchanger (BPHE) Cascade Condensers/Evaporators.

The condensing of CO<sub>2</sub> vapour is achieved by two in parallel BPHE Cascade Condensers/Evaporators. BITZER CO<sub>2</sub> Hybrid racks use liquid refrigerant (typically R134a) from the high stage of the cascade system to condense the CO<sub>2</sub> through Direct Expansion (DX) in the BPHE condenser. The direction of flow of the R134a is always in counter flow to the CO<sub>2</sub>, see Figure 7.1.

### 9.6 Ancillaries/Electronic Expansion Valve (EEV)

Control of the condensing process is regulated typically by an EEV; the EEV is not supplied as part of the BITZER scope of supply and is selected and fitted by the contractor.



#### ATTENTION!

Care should be taken when selecting, installing and commissioning of the EEV as erratic superheat control WILL lead to the premature failure of the BPHE condenser.

## 9.7 EEV Superheat Control

It is imperative that stable superheat is maintained at all times during the condensing process, there are several other system related processes that influence the ability to maintain stable superheat namely:

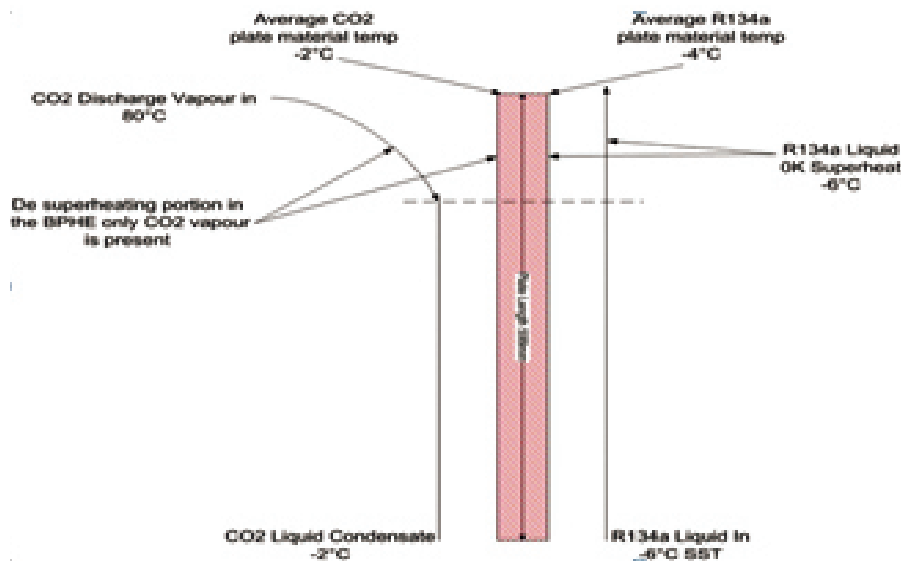
- Compressor Cycling
- De-superheater control
- Defrost loads
- Suction Superheater Control

The above will be explored in greater detail in other sections of this document and this section will concentrate on the actual EEV and the effects of unstable superheat control.

Figure 9 shows the effect of unstable superheat on the CO<sub>2</sub>/R134a condensing process. The CO<sub>2</sub> side of the process remains the same as in Figure 8 where CO<sub>2</sub> vapour is first de-superheated and then condensed, as before the top portion of the BPHE on the CO<sub>2</sub> side contains only vapour. The actual plate material temperature is around 59°C. However on the R134a side there is no superheat present and there is liquid R134a present all the way through the channel plate on the R134a side, this has two affects

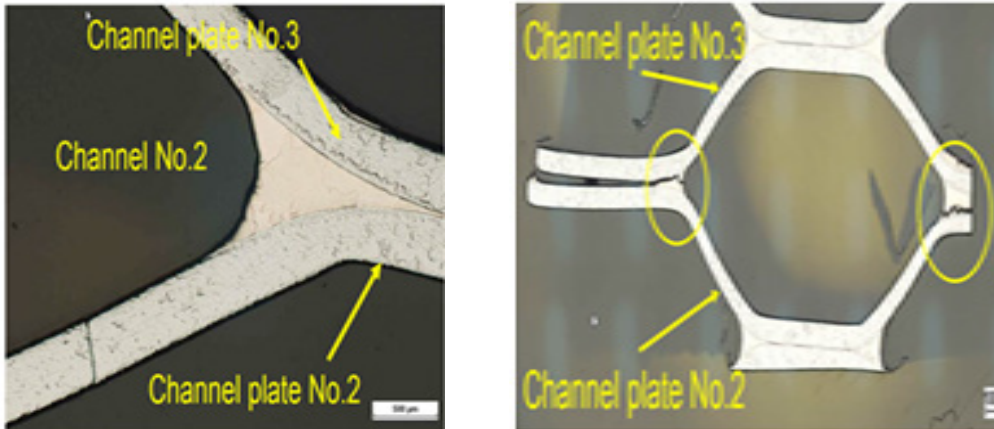
1. The BPHE material rapidly cools down from an average of 59°C to around -2°C, this rapid cooling creates tearing forces on the BPHE stainless steel material.
2. The cooling of the BPHE stainless steel material causes the BPHE material to contract (by up to 1mm), when the EEV restores positive superheat the BPHE stainless steel material expands.

**Figure 9 - CO<sub>2</sub>/R134a Condensing Process with Unstable Superheat**



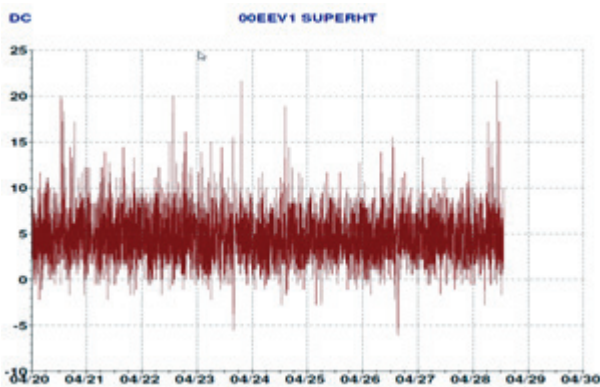
A continuous fluctuation in superheat as described (Figure 9) and the effects of (Figure 10) points 1 and 2 **create cyclic fatigue on the BPHE material and will ultimately cause premature failure of the BPHE**. (Figure 11) shows microscopic analysis from an actual failure, continuous linear expansion and contraction of the stainless steel material produces cracks on brazing joints in the proximity of the R134a outlet/CO<sub>2</sub> inlet port

**Figure 10 - Microscopic Analysis of a BPHE Failure.**



**Figure 11 -** shows site data from an actual BPHE failure it can be clearly seen that the superheat control is unstable with continuous fluctuations around zero superheat.

**Figure 11 - Graph showing unstable EEV superheat control**



**Figure 12 -** shows the opening position of the same valve, it can be seen that the valve operating position is also erratic, moving from fully closed to wide open.

**Figure 12 - Graph showing unstable EEV Opening Position.**

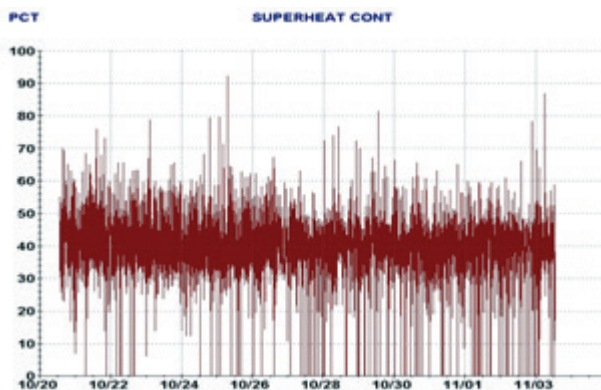
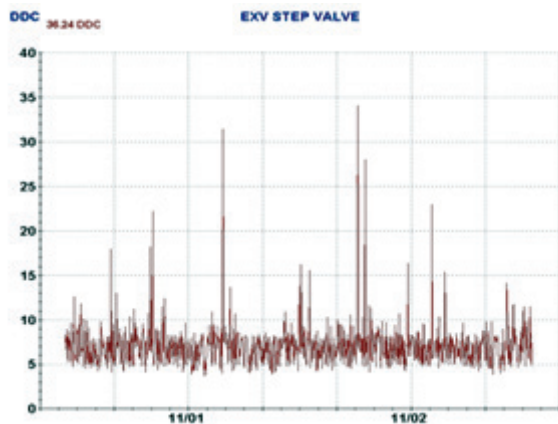


Figure 13 below shows the ideal superheat control of the EEV.

Figure 13 - Graph showing stable EEV Superheat.



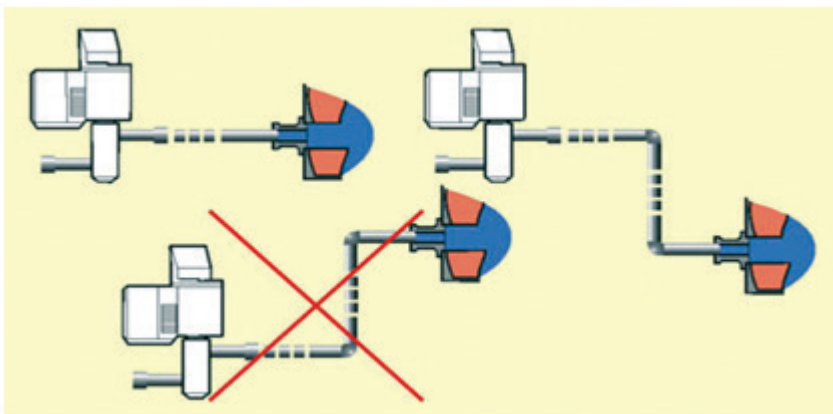
### ! ATTENTION!

Failure to maintain stable superheat will void all warranty on the BPHE, BITZER Australia reserve the right to request periodic graphical data in the event of BPHE failure.

## 9.8 Piping Recommendations for EEV

Figure 14 shows the recommended position of the EEV relative to the inlet port. The EEV should be mounted in the horizontal position relative to the inlet connection, with a straight pipe in between. The pipe between the EEV and the BPHE inlet should be between 150mm-300mm long or with a ratio of pipe length to pipe inner diameter of 10-30.

Figure 14 - Recommended Positions for EEV



## 9.9 Ancillaries BPHE [OPTIONAL] HOT WATER [HEAT RECLAIM UNIT]

BITZER CO<sub>2</sub> Hybrid Racks are available with (OPTIONAL) HOT WATER BPHE. This consists of a Dual Wall Stainless Steel Brazed Plate Heat Exchanger engineered to application. The Dual Wall BPHE is intended for potable water applications. NOTE: Water mark level 1. Certificate of conformity AS/NZS 3498:2009 CERTIFICATE No. 23131.

## 9.10 Water Connection to the HOT WATER BPHE. (Heat Reclaim Unit)

### Installation:

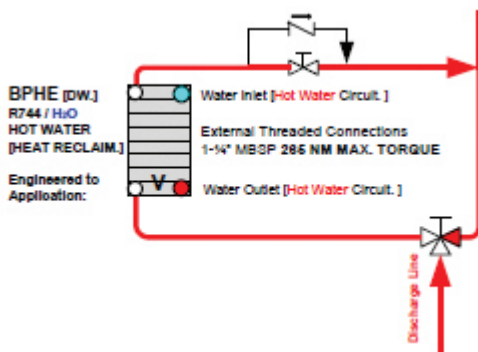
Of water plumbing connection for a dedicated Hot Water circuit to the (OPTIONAL) HOT WATER BPHE.

Ensure that the refrigeration contractor/s has successfully pressure tested / leak tested the HOT WATER BPHE prior to installation of plumbing [water] circuit.

The HOT WATER BPHE Ø1-1/4" MBSP water connections are to be connected counter flow to the refrigeration fittings by a registered, licensed Plumber. We recommend that additional BSP sockets/valves be installed within the water circuit for periodic water circuit cleaning purposes.

The **maximum allowable connection load is 260 Nm Torque** with a maximum Bending Moment of 87 Nm. to the Ø1-1/4" MBSP Water fitting.

Ensure that all interconnecting plumbing (water pipes) are **structurally secured** before and after the BPHE.



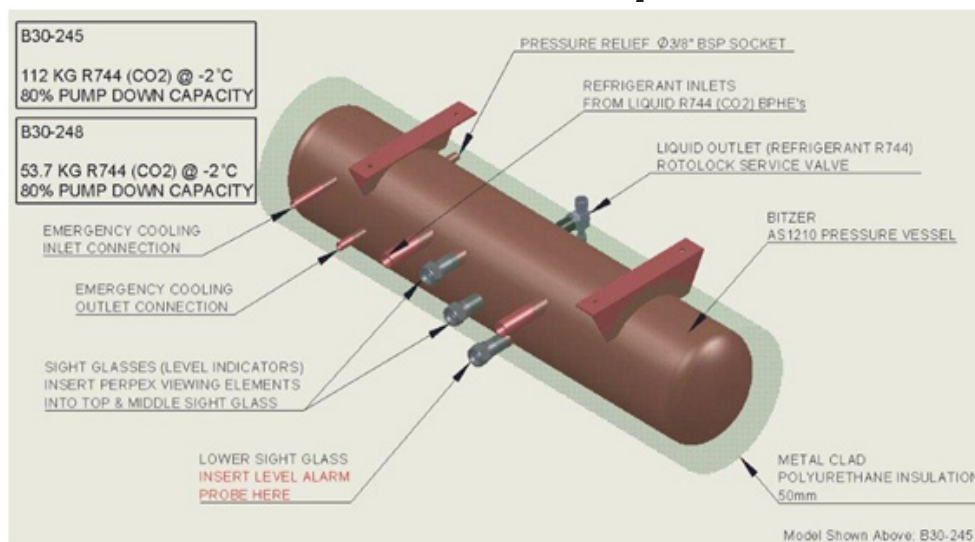
## 9.11 Cleaning of the HOT WATER BPHE.

Thanks to the normally high degree of turbulence in the BPHE there is a self-cleaning effect in the channels. However in some applications the fouling tendency can be very high. e.g. when using extremely hard water at high temperatures. In such cases it is always possible to clean the exchanger by circulating an approved cleaning liquid. [CIP Cleaning In Place] Use a tank with weak acid solution 5.0% phosphoric acid or if the exchanger is frequently cleaned a 5.0% solution of oxalic acid. For optimum cleaning the cleaning solution flow rate should be minimum 1.5 times the normal flow rate, preferably in a back flush mode. After use do not forget to rinse the exchanger carefully with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO<sub>3</sub>) before the last rinse ensures that all acid is neutralized. **(Check PH test sample of water leaving the BPHE after the cleaning process is complete)** Clean the BPHE water circuit at regular intervals.

## 9.12 Ancillaries Liquid Receiver

BITZER CO<sub>2</sub> Hybrid Racks are supplied with a CO<sub>2</sub> rated liquid receiver, the receiver comes with 50mm insulation and is encapsulated in a metal enclosure. All vessels are manufactured to AS1210. Figure 15 shows technical details for the different type of the receivers.

**Figure 15 - B30-245 Horizontal Liquid Receiver CO<sub>2</sub> Colorbond Metal Clad and insulated.**

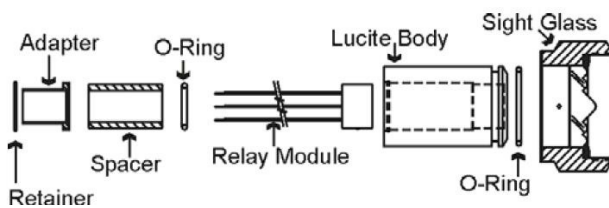


1. Two of the Frost Shield [Perspex viewing elements] are supplied within the accessories carton. Gently insert one Frost Shield viewing element horizontally into the top sight glass and the other into the middle sight glass.
2. One of the HENRY E-9224 liquid level sensors is supplied within the accessories carton. Gently insert horizontally the liquid level sensor into the bottom sight glass and wire to switchboard/control system.
3. NOTE: It is imperative that the Liquid level Alarm sensor be tested during commissioning and periodically when general maintenance occurs.

### 9.13 Ancillaries/Liquid Level Alarm

- A low level liquid alarms are generated by a HENRY E-9224 liquid level sensor the switch is mounted horizontally in the bottom receiver sight glass (switch locates on O ring see Figure 16). The switch is nonintrusive and can be serviced without pumping down the receiver.
- The liquid level alarm probe is supplied loose within the accessories carton and must be installed into the bottom liquid receiver sight glass prior to, charging the system with refrigerant.

**Figure 16 - Liquid Level Switch Details (Disassembled View).**



**Check and Test-function of the low level Alarm probe during Commissioning.**

**Figure 17 - Liquid Level Switch Wiring Details**

Voltage: 24V AC/DC      Rating: 0.5Amp      Contact When liquid present: 9424 N/C 9424A N/O  
Min/Max Fluid Temp Range: -40°C to 98°C Working Pressure: 8273kPa



### **WARNING!**

**All electrical wiring should be carried out by qualified persons and in accordance with AS300 or equivalent standard in the country of installation.**



#### 9.14 Ancillaries/Filter Driers & Moisture

The solubility of water in CO<sub>2</sub> vapour is considerably lower than in other refrigerants, as a consequence a relatively low moisture content can freeze out of the refrigerant and block control valves. Excessive moisture can also lead to a build-up of organic acid as the moisture reacts with both the CO<sub>2</sub> and the POE oil. Therefore all BITZER CO<sub>2</sub> DX Hybrid racks come fitted with a generously sized liquid drier complete with 2 x 100% molecular sieve driers cores supplied loose.

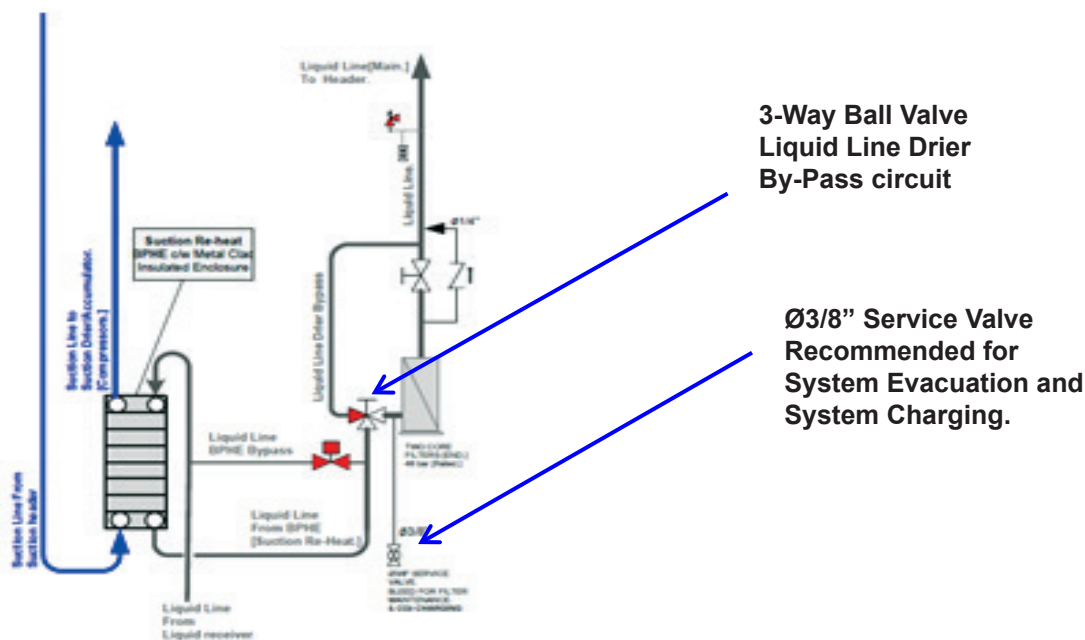
The drier shell is installed at the rear, right hand end of the rack encased in PVC tubing complete with urethane insulation.

1. Upstream of the Drier Shell is a service Charging / Drain Post Valve Ø3/8". See FIG 18
2. Upstream of the Drier shell is a Liquid line Three Way Ball Valve. See FIG 18
3. The Liquid Line can be temporarily diverted along the Liquid line By-Pass line during Drier changes. This means that the system can be fully functional, during liquid line Drier Core replacement.
4. Please note that the driers cores are supplied loose within the accessories carton and should be installed as part of the commissioning. See commissioning section .....
5. The Ø3/8" Post valve can also be employed for reclaim of residual CO<sub>2</sub> refrigerant from the Drier Shell cavity prior to Drier core changes.

**Figure 18 - Liquid Line Drier (End view showing insulated cover)**



**Figure 18A - Liquid Line Drier**



#### ATTENTION!

Only fit 100% molecular sieve driers when replacing liquid drier cores, excessive moisture content in the CO<sub>2</sub> will lead to a build-up of organic acid.



### 9.15 Ancillaries Suction Drier /Suction Accumulator

BITZER CO<sub>2</sub> Hybrid racks are equipped with a single core Suction Drier / Suction Accumulator Vessel. This is located at the back of the unit within a metal cradle at the rear right hand end of the rack frame assembly.

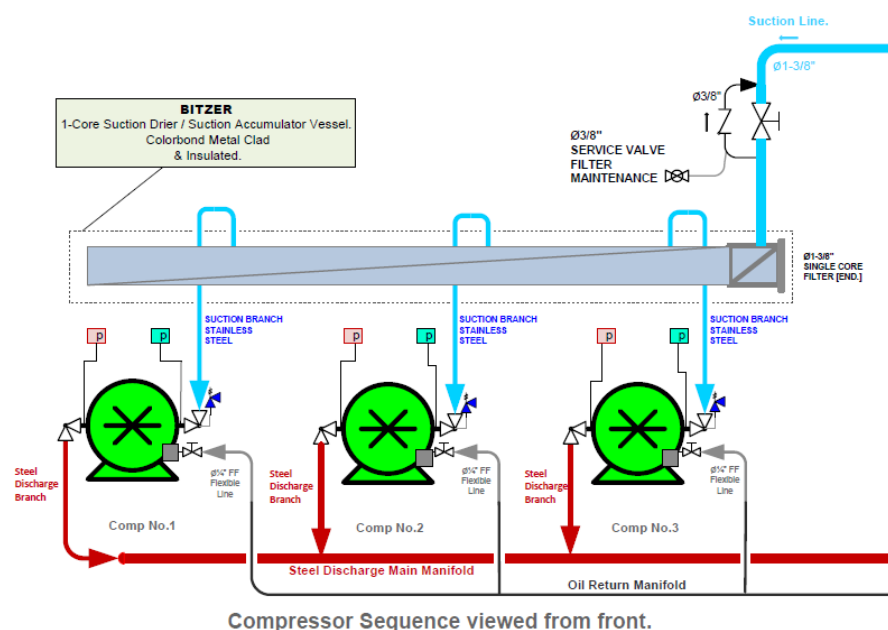
1. The Suction Drier / Suction Accumulator vessel is Colorbond metal clad and insulated.
2. There is a removable metal insulated cover at the suction inlet end of the vessel. (Drier Shell End Plate Access) See Figure 19
3. The insulated Individual Suctions lines along the top of the vessel are seamless stainless steel, sized to each specific compressor.
4. Please note that the suction felt is not fitted when the rack is supplied and should be installed as part of the commissioning. The suction felt should be removed after commissioning in order to avoid excessive pressure drop through the filter.
5. Burnt out cores should be installed in the event of a compressor burn out or high moisture content.
6. A Service valve Ø1/4"MSAE is connected upstream of the Suction Drier / Suction Accumulator to assist with changing drier cores.

**Figure 19 - Suction Drier/Suction Accumulator vessel Schematic**



1-Core Drier Shell End Plate Cover Access. This End.

**Figure 19A - Suction 1-Core Drier/Accumulator Vessel Schematic**



### 9.16 Ancillaries/Suction Superheaters

Due to the high solubility of CO<sub>2</sub> and POE oil it is essential that the compressor crankcase is kept above 20°C. Low crankcase temperatures will allow the high density CO<sub>2</sub> to dilute into the oil, leading to compressor failure.

The BITZER CO<sub>2</sub> Hybrid racks use several methods (depending on generation) to superheat the return CO<sub>2</sub> suction vapour, superheating the suction vapour raises the compressor discharge temperature, which in turn raises the oil temperature.

Although there is a slight decrease in COP with the additional increase in suction superheat, the decrease is less than if one were to use an external heater (additional parasitic load) to maintain crankcase temperature.

### 9.17 Suction Superheating



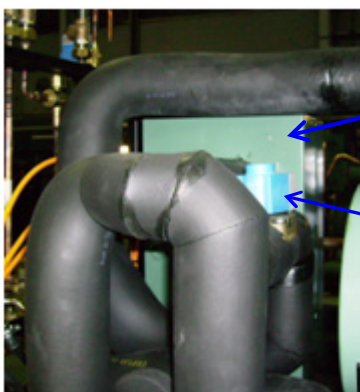
#### ATTENTION!

The set points listed below are advisory as each system varies depending on design conditions. Operation should be checked to ensure that the crankcase temperature operates between 20°C and 30°C.

### 9.18 Suction Superheating BPHE

Additional suction (return vapour) superheating is achieved by passing CO<sub>2</sub> High Pressure Liquid in counter flow to CO<sub>2</sub> suction return vapour. This style of superheating is less complicated and does not require as many control solenoids as the mass flow of CO<sub>2</sub> liquid and vapour is balanced. The suction re-heat BPHE is engineered to application

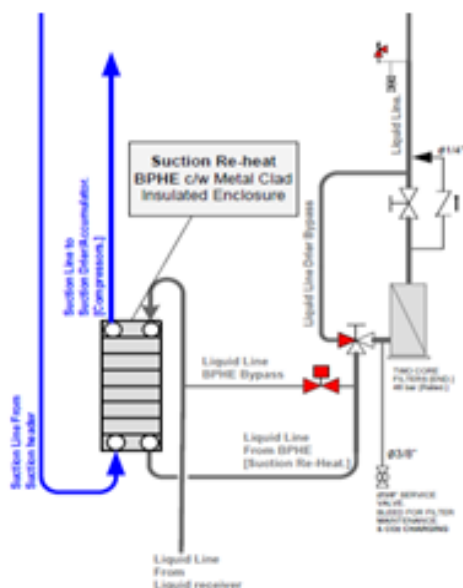
Figure 20 - Suction re-heat BPHE photo



Suction Superheating BPHE.  
CO<sub>2</sub> Suction Side and  
CO<sub>2</sub> Liquid Side.

Liquid line by-pass Solenoid.

Figure 20A - Suction R-Heat BPHE (Engineered to Application) Schematic.



Liquid line by-pass Solenoid Valve  
Set points:  
Solenoid: On -5°C Off -8°C

### 9.19 Ancillaries/Hot Gas Injection

All BITZER CO<sub>2</sub> Hybrid racks come fitted with a Hot Gas Injection solenoid (HGIS), the purpose of the HGIS to provide additional suction superheating if required or in the event of a malfunction of the suction superheater BPHE. The HGIS consist of a solenoid with two non-return valves (Figure 21). The solenoid injects hot gas from the discharge line directly into the CO<sub>2</sub> suction line upstream of the suction Drier/Accumulator vessel. In the event of the CO<sub>2</sub> suction return gas (vapour) remaining below -15°C

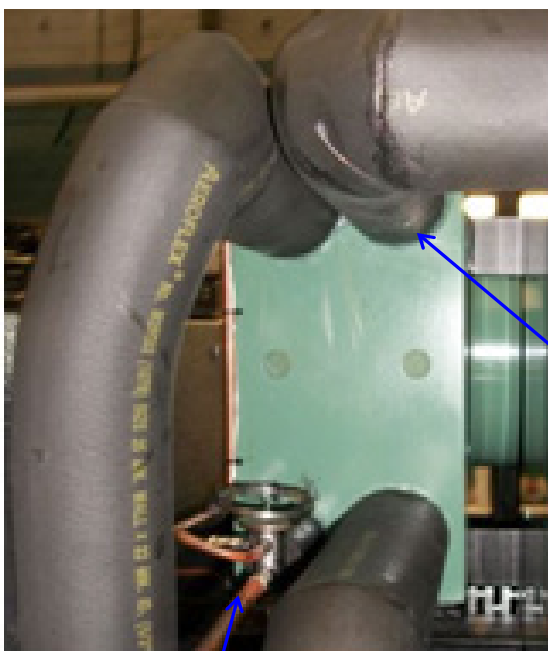
**Figure 21 - Hot Gas Injection Solenoid Schematic.**



### 9.20 Ancillaries/Emergency Cooling

BITZER CO<sub>2</sub> Hybrid racks come fitted with an Emergency Cooling BPHE fitted. The purpose of the emergency cooling BPHE is to provide cooling to the CO<sub>2</sub> refrigerant within the Liquid Receiver in the event of a power outage. The BPHE is connected to the CO<sub>2</sub> Liquid Receiver and includes a Tx Valve. R134a TUAE mechanical expansion valve, (R134a is standard other refrigerants valves available on request) the liquid line and suction line on the R134a require connecting to a dedicated condensing unit, (**Emergency Cooling Condensing Unit Optional**) available in 3 Phase or Single phase Compressor versions, each with a twin fan, air cooled condenser (vertical air discharge).

**Figure 22 - Emergency Cooling BPHE Photo.**



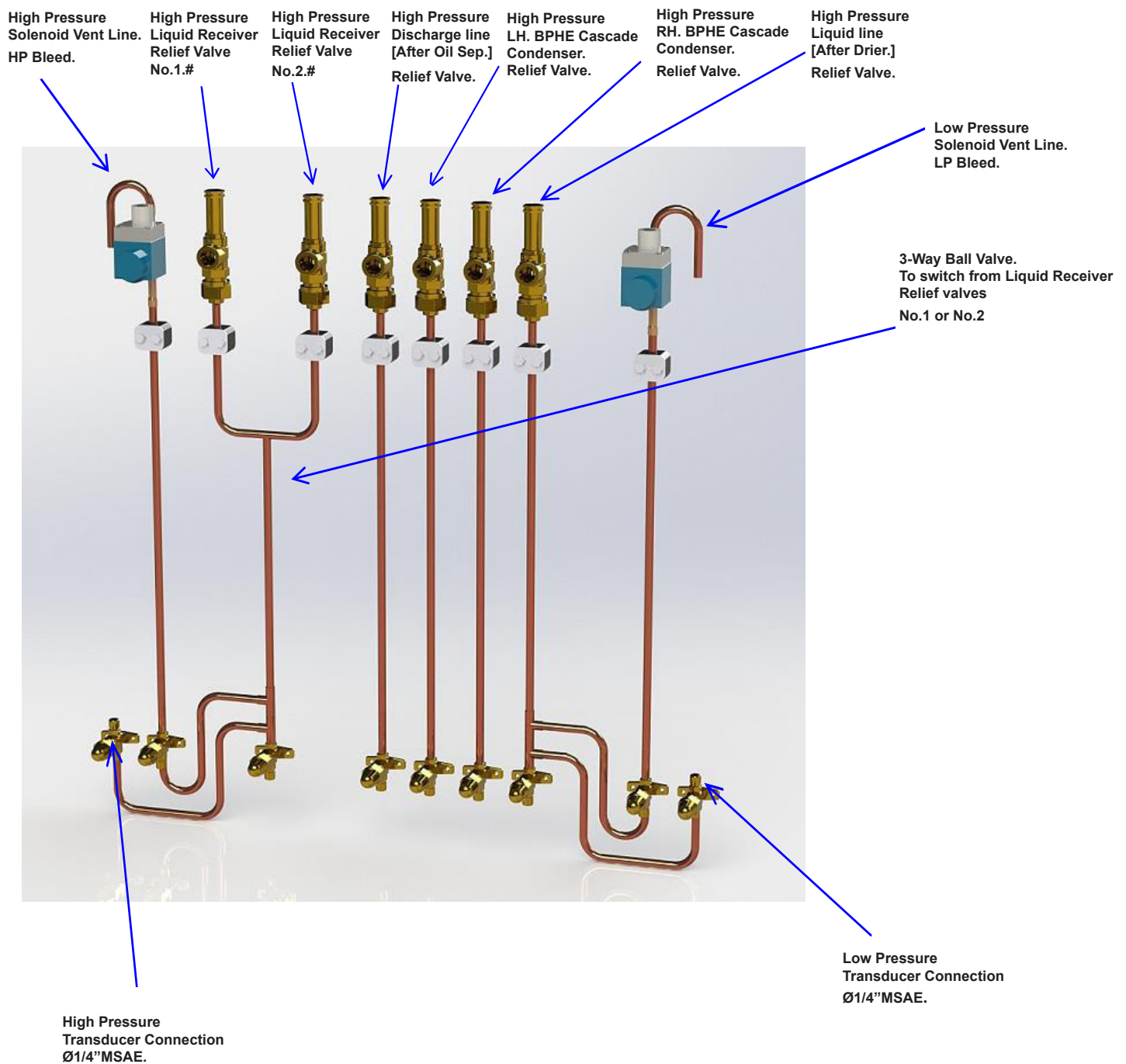
**Emergency Cooling BPHE.**  
CO<sub>2</sub> Condensing Side.  
R134a Evaporating Side.

**TX Valve R134a**  
**Danfoss Externally Equalised**  
**No. 7# Orifice**

An additional HP switch is fitted to control the condensing unit for the emergency cooling BPHE.

HP Switch 3 Function: Emergency Cooling BPHE Condensing unit Control  
Cut in 3800kPa Cut out 3600kPa

**Figure 22A - Location of PRV's on Rack. [Solenoids shown without Coils fitted.]**



## 9.22 Ancillaries Transducer Points

BITZER CO<sub>2</sub> Hybrid come with suction and discharge transducer post valves. Please note that the actual transducers are not part of the rack scope of supply (Transducers by others). The suction transducer post valve is connected the main suction header, the discharge transducer post valve is connected to the CO<sub>2</sub> liquid receiver.

## 9.23 Ancillaries Emergency Vent Solenoid (EVS)

The BITZER CO<sub>2</sub> racks come fitted with additional HP switches to control emergency vent solenoids. Emergency Vent Solenoids are included within the part of the scope of supply of the rack and should be relocated outdoors by the contractor/installer in the vicinity of the relevant main pressure reliefs valves. No additional pipework should be fitted on the outlet of the EVS as in the event of CO<sub>2</sub> been released dry ice will form at the point of expansion.

The purpose of the EVS is to relief pressure in the suction header and or the CO<sub>2</sub> liquid receiver before the pressure builds-up and the PRV's are activated.

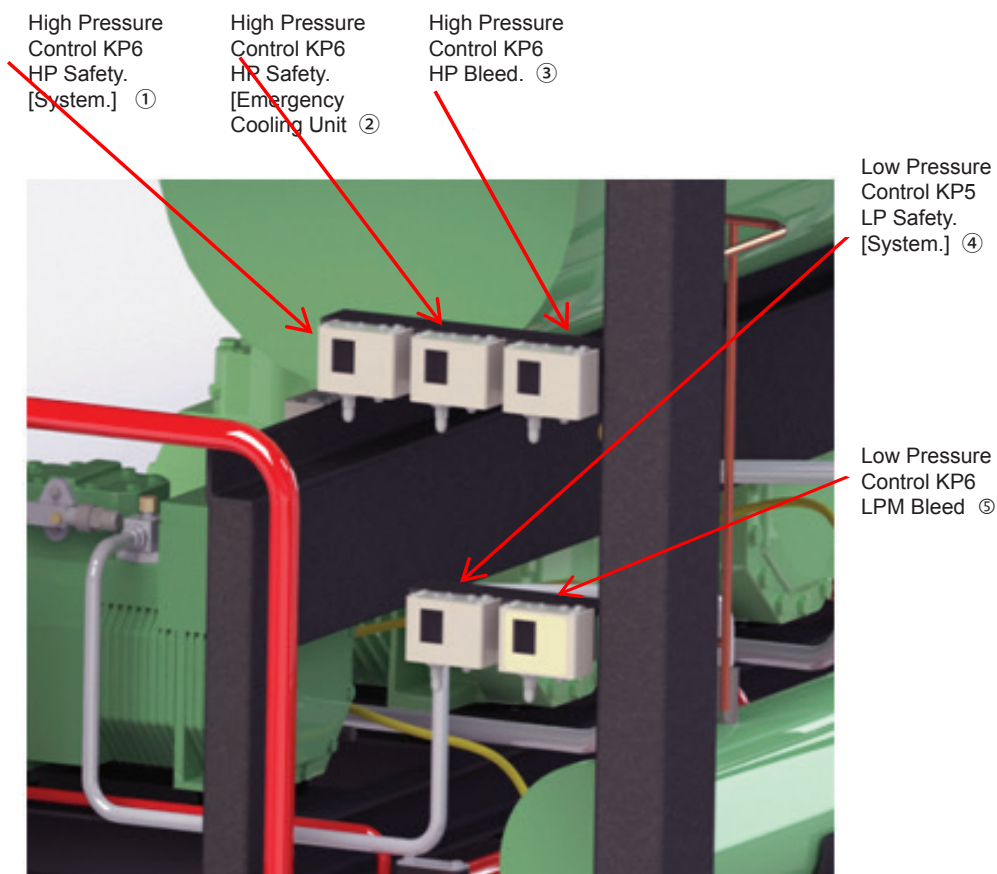
## 9.24 Ancillaries/Pressure Switches

All compressors come fitted with mechanical Low Pressure (LP) and High Pressure (HP) safety switches.

Recommended Settings Only

LP	Cut in	1200kPa	Cut out	560kPa
HP	Cut in	3200kPa	Cut out	3950kPa

**Figure 23 - Additional System Pressure Switches.**



The additional system pressure switches are located at the right hand end of the unit frame. Each pressure control has a dedicated isolation service valve for service purposes.

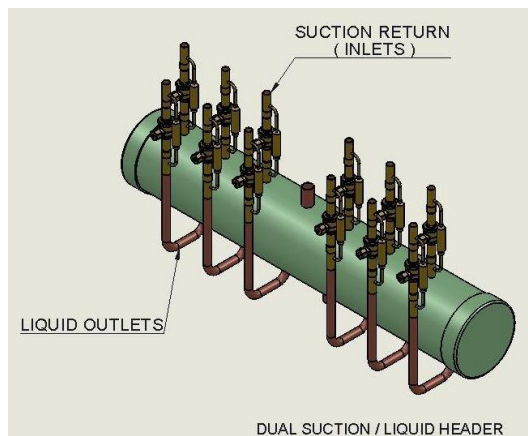
1. The High Pressure safety Control is for Rack Safety.
2. The High Pressure (Emergency Cooling Unit) control is to operate the Emergency Condensing Unit.
3. The High Pressure safety Control (HP Bleed) is for the HP Bleed Solenoid Valve.
4. The Low Pressure safety Control is for Rack Safety
5. The Low Pressure safety Control (LP Bleed) is for the LP Bleed Solenoid Valve.



### 9.25 Suction and Liquid Headers

BITZER CO<sub>2</sub> Hybrid Racks come fitted with six stub or eight suction and liquid headers (2 compressor racks have four stub headers fitted as standard). The headers are encased in 225mm PVC tubing complete with urethane insulation (Figure 24) to reduce condensation.

**Figure 24 - Suction & Liquid headers**



The dual Suction - Liquid header is specially designed for BITZER DX CO<sub>2</sub> systems. Both headers (Suction and Liquid headers) are fully sealed within the one PVC Insulated, enclosure providing compact, robust design. The Suction (Return Vapour) Inlet connections are located on the top of the enclosure and the Liquid outlet connections are located at the bottom of the enclosure with external pipework facing upwards. The dual suction headers are available in three combinations.

**For 2 Compressor Racks only:** 4 x Suctions Ø 7/8" and 4 x Liquids Ø7/8".

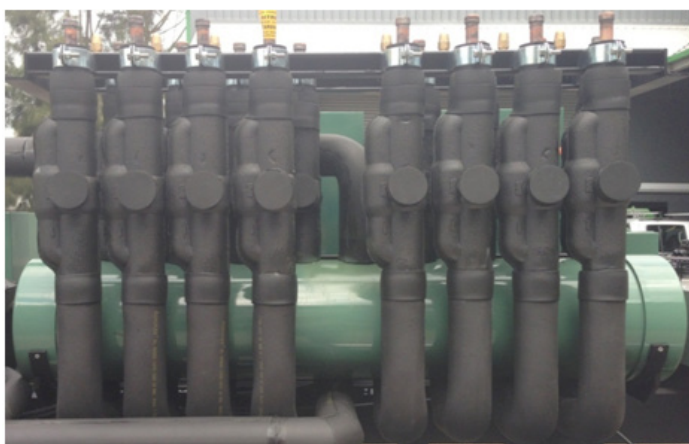
**For 3 or 4 Compressor Racks:** 6 x Suctions Ø 7/8" and 6 x Liquids Ø7/8".

**For 3 or 4 Compressor Racks:** 8 x Suctions Ø 7/8" and 8 x Liquids Ø7/8".

NOTE: Other combinations/sizes can be ordered as special applications.

1. The Suction return Inlets consist of 4, 6 or 8 stubs of Ø7/8" refrigeration pipe. Each complete with system ball valves with non-return valve (NRV) bypass. Suction stubs have an additional post valve fitted. This arrangement allows for the pumping down and evacuation of the field evaporators to be carried out from the rack.
2. The liquid Outlets 4, 6 or 8 stubs of Ø7/8" refrigeration pipe. Each complete with system ball valves with non-return valve (NRV) bypass.
3. The dual header design also provides additional Suction Superheating and Liquid Sub-Cooling with its internal pipe network.

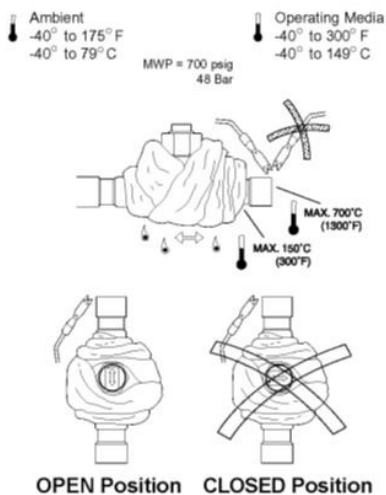
**Figure 24A - Suction and Liquid headers (Insulated)**



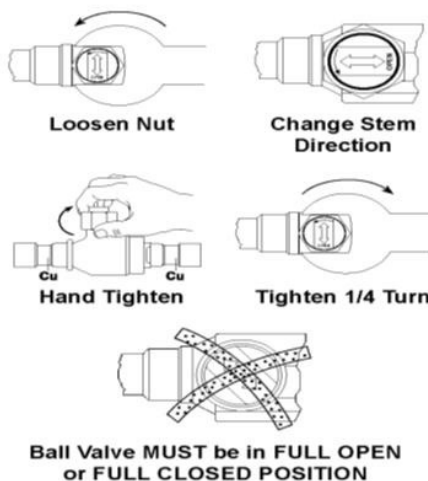
For Connection and operating instructions of the ball valves. See Figure 25. Note: Ensure that all site pipe work is structurally self-supported, prior to connecting to the BITZER CO<sub>2</sub> Hybrid Rack.

**Figure 25 - Connection & Operating Instructions for Ball Valves**

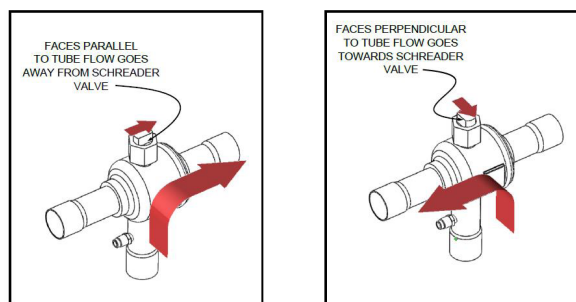
### Ball Valve Brazing Instructions



### Ball Valve Operating Instructions



**Figure 26 - Connection & Operating Instructions for 3- Way Ball Valves**



### The three way ball valves are primarily located;

- The Discharge line upstream of the Hot Water BPHE (When HW is BPHE fitted)
- The Discharge line prior to the Air Cooled De-Superheater.
- The Liquid Line upstream of the Liquid line By-Pass and Drier Shell.
- The liquid Receiver Pressure Relief Valves.

### Notes:

- The 3-way valves do not require Non- Return Valves (Check valves) in the current configurations.
- For 3-Way Valve Brazing (Soldering) instructions See Figure 26.



## 10. Commissioning/Pressure test

The entire system should be pressure tested prior to the evacuation process, the pressure test should be carried out with Dry Nitrogen, in accordance to relevant Australian / New Zealand standards.



**DANGER!**

**Under No circumstances is Oxygen or other industrial gases to be introduced.  
Do-not add HFC refrigerant as a leak indicator.**



**WARNING!**

**All work to be carried out to the relevant Standards by licensed accredited personal.**

Ensure that the **test pressure does not exceed 2500kPa on the low side and 4000kPa on the high side.**

Test / Inspect all components / connections for leaks. Employ the soapy water method of leak detection to system joints-junctions while system is at test pressure. We also recommend the use of quality electronic CO<sub>2</sub> Leak detectors to ensure system integrity.

**Warning: Electronic CO<sub>2</sub> leak detectors can/may register CO<sub>2</sub> presence in the expanded polyurethane foam (insulation) within the Headers / BPHE Enclosures / Pressure Vessels Insulation.**

When the pressure test/s are completed record findings.

When the pressure test/s are completed reduce the system pressure to a safe holding pressure, recommend 500 kPa.

### 10.1 Commissioning/Evacuation and Dehydration.

The BITZER CO<sub>2</sub> Hybrid rack requires a minimum evacuation of 500 microns, we therefore recommend the following:

- Employ the Triple Evacuation Process.
- Evacuate with two-Stage vacuum pump/s sized to application.
- Provide new (approved) vacuum pump oil to the vacuum pump/s prior to evacuation.
- Employ Ø3/8" hoses [minimum size.] to both high and low sides of system.
- Ensure that all circuits of the CO<sub>2</sub> system are all evacuated.
- Ensure that the Compressors and the Oil Separator/Reservoir are drained of oil prior to evacuation. **[Label all Compressors and the Oil Separator/Reservoir stating that they are drained of Oil]**
- Ensure that all Solenoid valves are fully open during the evacuation process. This can be achieved by energising the coils or replacing them with coil magnets during this process. [Important: Replace any coil magnets with the appropriate Solenoid coil/s once evacuation process is fully completed]
- Ensure that the Electronic TX valves are fully open during the evacuation process.
- Employ accurate gauges for measuring vacuum e.g. Digital vacuum gauge (correctly calibrated / certified)
- Commence the 1st evacuation. During this initial process, Test vacuum to check for inward leaks. During initial evacuation. Leave vacuum to stand for a period and record vacuum findings. If pressure rises rapidly showing a possible inward leak. Evacuate different sections one at a time to determine leak source. Once leak is located and fully repaired, pressure test / leak test system prior to recommencing evacuation.
- Option on larger plants isolate sections of the refrigeration plant and Evacuate different sections one at a time or employ several vac pumps one on each section of the system.
- During initial evacuation, open the 2-Stage vacuum pump/s gas ballast valve to exhaust/remove any non-condensable's entering the vac pump. Once a low vacuum is approaching close the Ballast valve to achieve lowest vacuum.
- Once the first evacuation is successfully completed. [Record findings within commissioning report]
- Ensure that the vacuum testing instruments are disconnected or isolated.
- Break the 1st vacuum with dry nitrogen to a positive pressure. Install all system drier/filter cores between the first and the second evacuation. [Keep any exposure of the system to atmosphere to a minimum]
- **Install BITZER approved BSE60K refrigeration oil to each compressor and Oil Separator/Reservoir between the first and the second evacuation.**
- Commence 2nd evacuation process and reinstate the vacuum testing instruments. Activate heaters.
- Once the 2nd vacuum is achieved [Record findings within commissioning report.]
- Ensure that the vacuum testing instruments are again disconnected or isolated.
- Break the 2nd vacuum with refrigeration grade R744 CO<sub>2</sub> vapour only to a positive pressure. [We recommend charging the vapour R744 CO<sub>2</sub> through a drier shell with a drier core/s fitted.]
- Commence 3rd evacuation process. And reinstate the vacuum testing instruments.
- Once the 3rd [final.] vacuum is achieved [Record findings within commissioning report.]
- The system is now ready for R744 CO<sub>2</sub> refrigerant charging. [System must be charged from a vacuum with vapour R744 only.]

**For locations of Evacuation Connections refer List below and Figure.1 BITZER CO<sub>2</sub> Hybrid Rack Schematic .**

1. The Liquid line Ø3/8" MSAE Post valve upstream of the 2-Core liquid line Drier.
2. The Suction Line Ø3/8" MSAE Post valve upstream of the Suction Drier/Accumulator vessel.
3. The Ø1/4" MSAE Post valves at the Suction header. [One per Suction Inlet.]
4. The Compressor service valve Ø1/4" MSAE connections. [DL and SL Valves]

## 10.2 Commissioning/Oil

Oil type: BITZER BSE 60K (POE)



### ATTENTION!

The POE oils used in the BITZER CO<sub>2</sub> Hybrid rack is hygroscopic, when exposed to the atmosphere it absorbs moisture. Excessive moisture in the CO<sub>2</sub> can lead to a build-up of organic acids as the free moisture reacts with both the POE and the CO<sub>2</sub>.

- Do not reuse drained oil that has been exposed to the atmosphere.
- The minimization of system internals, exposure to atmosphere.
- The use of 100% molecule sieve driers only.
- Check operation of crankcase heaters during evacuation.

## 10.3 Commissioning/Controls

Special attention must be taken in the control strategies used to control the BITZER CO<sub>2</sub> Hybrid rack and the high stage rack: the very minimum we require the following.

- The use of electrical interlocks to prevent the BITZER DX Hybrid CO<sub>2</sub> rack operating without the high stage rack operating.
- Evaporator and fans should be staged off in the event of the suction pressure reaching 2200kPa.
- Evaporators and fans should be staged back on after a power outage.

## 10.4 Commissioning/Starting Up and Charging



### WARNING!

The following should only be carried out by suitably qualified refrigeration technician. Ensure that all gauges are accurate and hoses are in good condition and have sufficient pressure rating.

A Risk Assessment and SOP should be completed before this work is carried. Appropriate PPE must be worn.

The high stage system and emergency cooling unit must be commissioned with all safety and control circuits proven. All safeties and control circuits on the BITZER CO<sub>2</sub> Hybrid Rack should be set and tested.

Energise the crankcase heaters and ensure that the oil temperature is between 35°C to 40° and that there is sufficient oil in the compressors and the oil separator.

- ☐ The BITZER DX Hybrid CO<sub>2</sub> unit should be charged with refrigeration grade R744, CO<sub>2</sub> with a **moisture content of 10 parts per million or less.**

**Extreme care must be taken when charging the system with R744**

**From a vacuum: Only Vapour Charge R744 Refrigerant into The Refrigeration System.**

1. Connect the refrigerant charging line into the system 3/8" MSAE Charging Service Valve. This ensures refrigerant charging through the systems dual core liquid line drier.
2. We recommend an additional 100% molecular sieve driers/shell be installed in the charging line to further ensure that the system is charged with Dry R744.
3. This system must be vapour charged with R744 until the system pressure is above 600kPa
4. Only when the entire system is at 500kPa or greater can you then begin to Liquid Charge R744 CO<sub>2</sub> into the Liquid Line Charging Service valve Ø3/8" MSAE. And the Liquid Receiver, once an overall all system pressure of above 600kPa has been reached.
5. Continue charging liquid into the receiver until a level is clearly visible in the second sight glass. Once this level has been reached turn on one sub system at a time, do not turn to many sub systems at once as this can lead to a rapid rise in pressure.
6. Add additional refrigerant as required.
7. Vapour can be charged into the liquid receiver, wet gas return or dry suction.
8. Liquid can be charged in to the liquid receiver or liquid line.
9. Ensure that the system is sufficiently charged with R744, CO<sub>2</sub>



### WARNING!

**CHARGING LIQUID CO<sub>2</sub> INTO THE SYSTEM AT PRESSURES BELOW 500kPa CAN LEAD TO THE FORMATION OF CO<sub>2</sub> IN A SOLID FORM (DRY ICE).**



#### **WARNING!**

Do not overcharge system with refrigerant.



#### **ATTENTION!**

Avoid high cycling rates on compressors.



#### **ATTENTION!**

Switch off compressors immediately, upon exceeding the application limits or in case of abnormal conditions (e.g. wet operation). Only switch compressors back on when pressure levels are stabilised or after correcting any faults.



#### **ATTENTION!**

Avoid rapid pressure pull down inside the crankcase when starting and during operation, as this will lead to oil foaming and result in a lack of lubrication.

### **10.5 Commissioning/Checks**

The following should be checked and verified as part of the commissioning procedure.



#### **ATTENTION!**

**BITZER Australia reserve the right to request one week's running data from newly commissioned sites as proof that the BITZER CO<sub>2</sub> Hybrid rack is operating within its design envelope. Failure to do so may result in voiding warranty on certain componentry**

- Set all system pressure (compressor safety) controls as described in section 6.
- The superheat operation of the High Stage Cascade EEV must be checked and verified that the conditions described in section 6.12 do not exist.
- Operation of suction superheater should be verified and compressor crankcase, discharge temperature and suction temperature should be logged.
- The mains power to the plant should be turned off to the BITZER CO<sub>2</sub> Hybrid Rack. The operation of the Emergency Cooling BPHE needs to be checked.
- Operation of the air cooled de-superheater should be checked, continuous cycling of the de-superheater fans should be avoided. All de-superheater fans should be off when the CO<sub>2</sub> outlet vapour temperature reaches 12°C.
- Case defrost should be set so that excessive loads are created.
- Operation of low liquid level alarm should be verified
- Cycling frequency of compressors should be checked, compressor starts should not exceed eight starts per hour, min operating time two minutes

## 11. Commissioning Sheet. #

BITZER COMMISSIONING DATA SHEET						
DESCRIPTION	VALUE	COMPRESSOR NO. 1	COMPRESSOR NO. 2	COMPRESSOR NO. 3	COMPRESSOR NO. 4	
BITZER RACK SERIAL NO.						
BITZER COMPRESSOR MODEL NO.						
BITZER COMPRESSOR SERIAL NO.						
COMPRESSOR PRESSURE RELIEF VALVE (FITTED)	25 Bar					
COMPRESSOR SUMP HEATER (FITTED & CHECKED)	√ or X					
COMPRESSOR RUN AMPS <b>RWB</b>	Amp.	/	/	/	/	/
SUCTION PRESSURE	Kpa					
SUCTION TEMP.	°C					
SUCTION TEMP. Hot Gas Injection Solenoid	°C					
SUCTION REHEAT bphe by-pass Solenoid setting	°C					
DISCHARGE PRESSURE	Kpa					
DISCHARGE TEMP. Compressor	°C					
DISCHARGE TEMP. Main Discharge Manifold	°C					
DISCHARGE TEMP. Entering Air Cooled De-Superheater	°C					
DISCHARGE TEMP. Exiting Air Cooled De-Superheater	°C					
DISCHARGE TEMP. Entering Liquid Receivers Internal Sparge Manifold	°C					
LP CONTROL SETTING (Compressor)	Kpa					
HP CONTROL SETTING (Compressor)	Kpa					
LP CONTROL SETTING (Rack)	Kpa					
LP CONTROL SETTING (LP Bleed)	Kpa					
HP CONTROL SETTING (RACK)	Kpa					
HP CONTROL SETTING (LP Bleed)	Kpa					
HP CONTROL SETTING (Emergency Cooling)	Kpa					
ANTI-SHORT CYCLING SETTING	Min.					
COMPRESSOR OIL LEVELS	%					
OIL SEPARATOR / RESERVOIR LEVEL	%					
TEMPRITE PRESSURE DIFFERENTIAL INDICATOR READING	bar					
TRAX OIL LEVEL CONTROL CHECK						
LIQUID RECEIVER LIQUID LEVEL	%					
LIQUID LEVEL OPTICAL LEVEL SENSOR TEST	√ or X					
LP TRANSDUCER # CHECK	√ or X					
HP TRANSDUCER # CHECK	√ or X					
<b>HIGH STAGE SYSTEM 134a</b>						
HIGH STAGE SYSTEM R134a CHECK FOR OPERATION/COMMISSIONING	√ or X					
HIGH STAGE SYSTEM R134a SUCTION SUPERHEAT RIGHT HAND SUCTION LINE	°C					
HIGH STAGE SYSTEM R134a SUCTION SUPERHEAT LEFT HAND SUCTION LINE	°C					
HIGH STAGE SYSTEM R134a AKV OR EEV SETTING	°C					
LIQUID SEPARATION VESSEL R134a LEVEL	%					
LIQUID SEPARATION VESSEL R134a SHP LEVEL PROBE	√ or X					
LIQUID TEMP. R134a ENTERING BPHE	°C					
LIQUID TEMP. R134a EXITING RIGHT HAND SIDE OF BPHE	°C					
LIQUID TEMP. R134a EXITING LEFT HAND SIDE OF BPHE	°C					
<b>REMOTE EMERGENCY BACKUP CONDENSING UNIT</b>						
BITZER COND. UNIT MODEL NO.						
BITZER COND. UNIT SERIAL NO.						
COMPRESSOR RUN AMPS <b>RWB</b>	Amp.	/	/	/	/	/
SUCTION PRESSURE	Kpa					
SUCTION TEMP.	°C					
DISCHARGE PRESSURE	Kpa					
DISCHARGE TEMP.	°C					
LP CONTROL SETTING	Kpa					
HP CONTROL SETTING	Kpa					
COMPRESSOR OIL LEVEL	%					



## 12. Service and Maintenance Program:

BITZER Australia recommends that the following service and maintenance checks should be carried out as a minimum requirement.



### ATTENTION!

Failure to comply with the schedule listed below and to maintain accurate service and maintenance records may result in premature failure and poor operation of the BITZER CO<sub>2</sub> Hybrid rack and will affect any warranty claims.

#### First 100 Hours of operation:

- Change compressor oil.
- Clean compressor oil filter and magnetic plug.
- Replace main oil strainer. [replace oil Filter with new approved model] BITZER COS-Oil Separators. If Temprite Oil separator employed check pressure differential indicator and replace Temprite cartridge with spare.
- Take oil sample for analysis.
- Check evaporators (frost patterns)
- Check high stage rack system.
- Log system/s operating parameters. (Both DX CO<sub>2</sub> and High stage Plant.)
- Check operation of emergency cooling unit.
- Check for abnormal noise and vibration.
- Check compressor crankcase temperatures.
- Check all refrigeration unit pipe clamps [Stauff Clamps.] for tightness.
- Check Air Cooled De-Superheater.
- Check electrical cables for tightness
- Check Electrical Switchboard/s for hot spots [ Laser – Thermal – Sensor]
- Leak test plant.
- Record all 100 hour maintenance checks.

#### Monthly

- Check system operating conditions.
- Check operation of emergency cooling unit.
- Check for abnormal noise and or vibration.
- Check compressor oils for bubbles, cleanliness and levels.
- Check CO<sub>2</sub> refrigerant level (Liquid Receiver).
- Check for oil leaks
- Check operation of EEV's (operation and superheat setting.)
- Check operation of suction superheat (BPHE) control.
- Log system/s operating parameters
- Check electrical cables for tightness
- Leak test plant.
- Record all monthly maintenance checks.

#### Quarterly

- Check system operating condition.
- Check operation of emergency cooling unit where applicable. [Check cleanliness of the Emergency Cooling Unit Condenser Coil.]
- Check operation of Remote Air Cooled De-Superheating Unit where applicable. [Check cleanliness of Coil. Check fan Motors. Check operation]
- Check for abnormal noise and or vibration.
- Check compressor oils for cleanliness and levels.
- Check CO<sub>2</sub> refrigerant level (liquid receiver).
- Check for oil leaks.
- Check operation of EEV's (operation and superheat setting.)
- Check operation of suction superheat (BPHE) control.
- Log system/s operating parameters.
- Check all pipe clamps for tightness.
- Check electrical cables for tightness.
- Leak test plant. Record all monthly maintenance checks.
- Record all quarterly maintenance checks.

## 12. Service and Maintenance Program: Continued.

### Annually

- As per monthly check with the additional check listed below.
- Change compressor oil.
- Clean each compressors oil filter and magnetic plug.
- Replace main oil strainer. [replace oil Filter with new approved model] BITZER COS-Oil Separators. If Temprite Oil separator employed check pressure differential indicator and replace Temprite cartridge with spare.
- Replace liquid line drier cores.
- Take oil sample for analysis.
- Check operation of safety circuits.
- Check high stage rack system.
- Check all refrigeration unit pipe clamps [Stauff Clamps.] for tightness.
- Check operation and calibration of plant room CO<sub>2</sub> refrigerant detection system.
- Check plant room ventilation system.
- Record all annual maintenance checks.

## 13. Drawings

**Figure 27 - BITZER 3 Compressor CO<sub>2</sub> DX Hybrid Low Temperature Rack.**

- Frontal view showing right hand side.

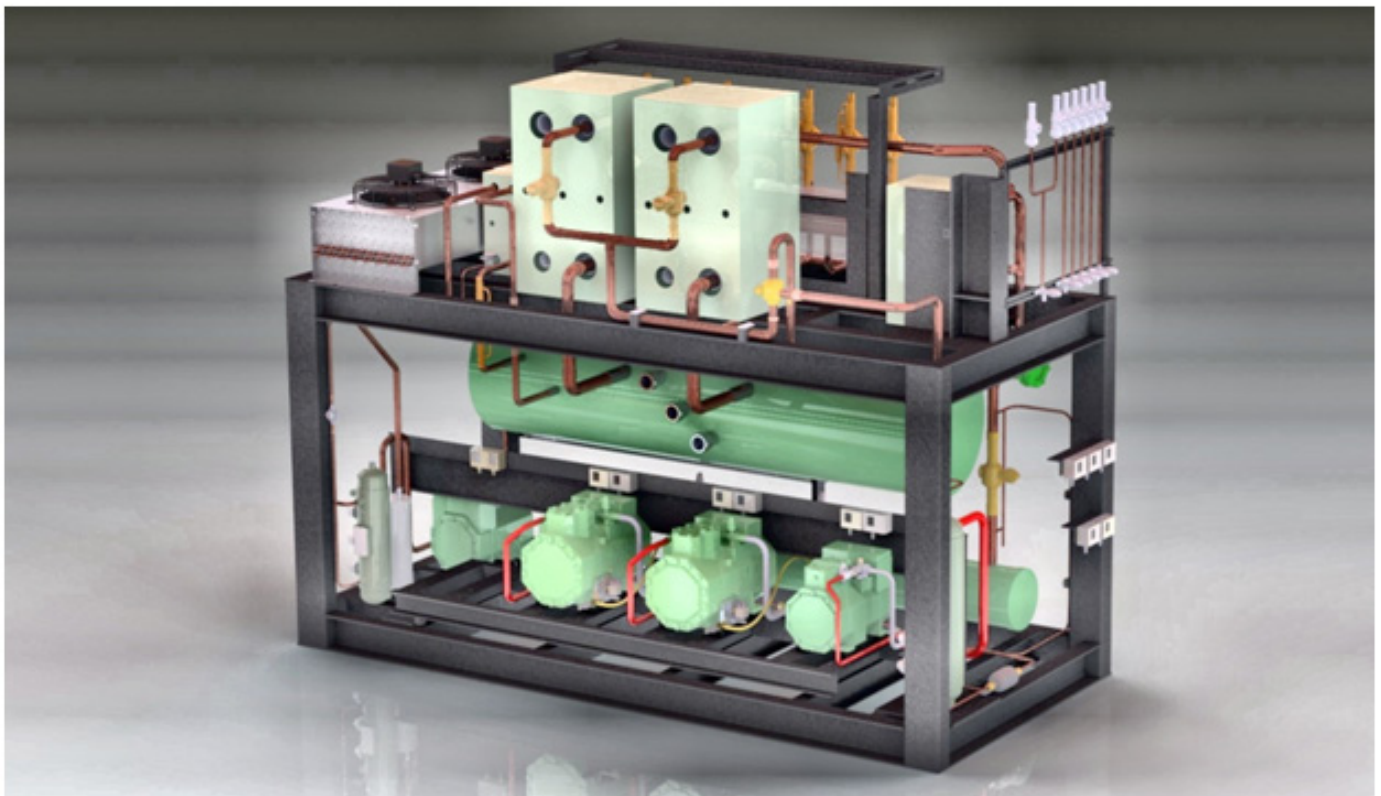




Figure 28 - BITZER 3 Compressor CO<sub>2</sub> DX Hybrid Low Temperature Rack.

- Frontal view showing Left hand side with optional [Integral Emergency Cooling Unit and rear mounted Integral Air Cooled De-Superheater.]

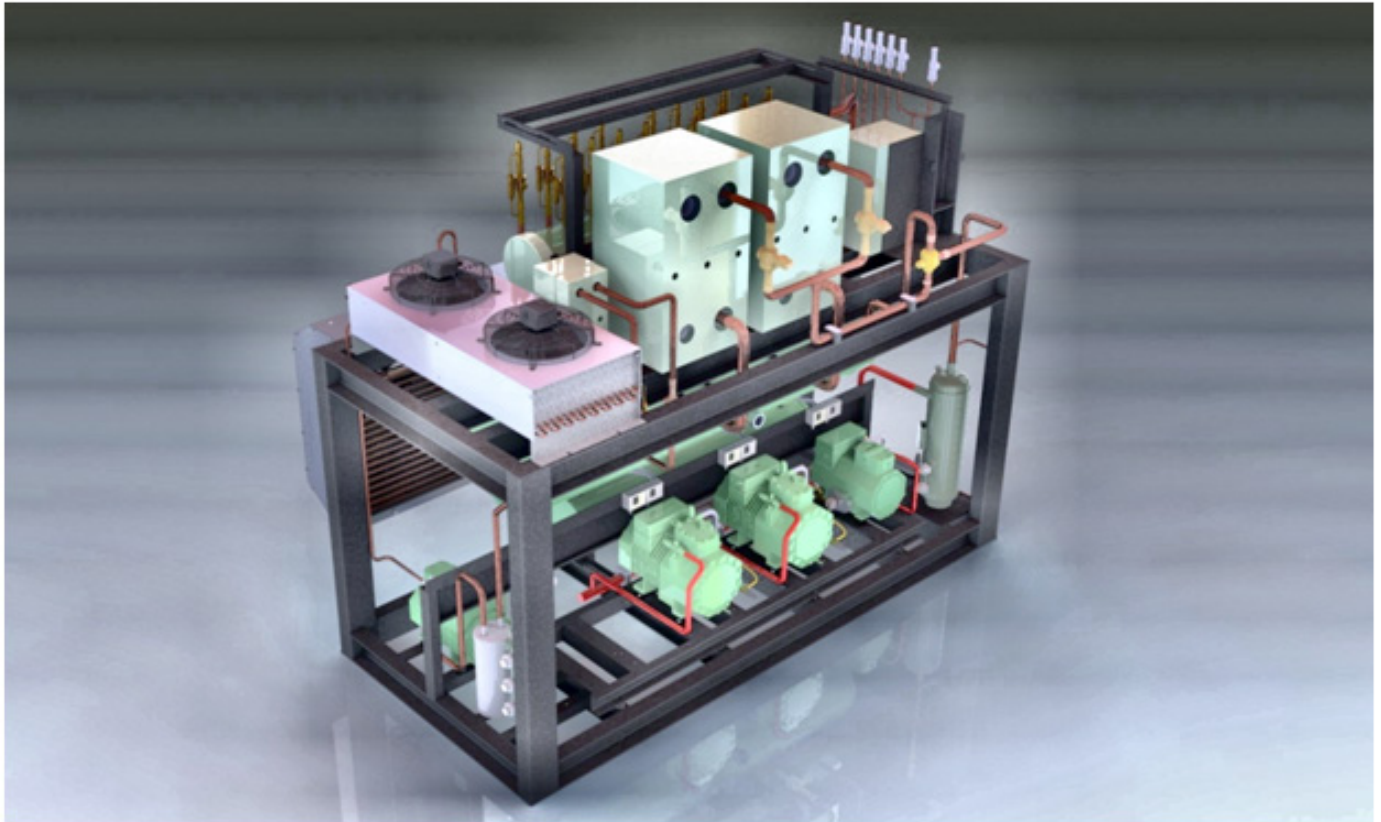


Figure 29 - BITZER 3 Compressor CO<sub>2</sub> DX Hybrid Low Temperature Rack.

- Side view showing Right hand side.

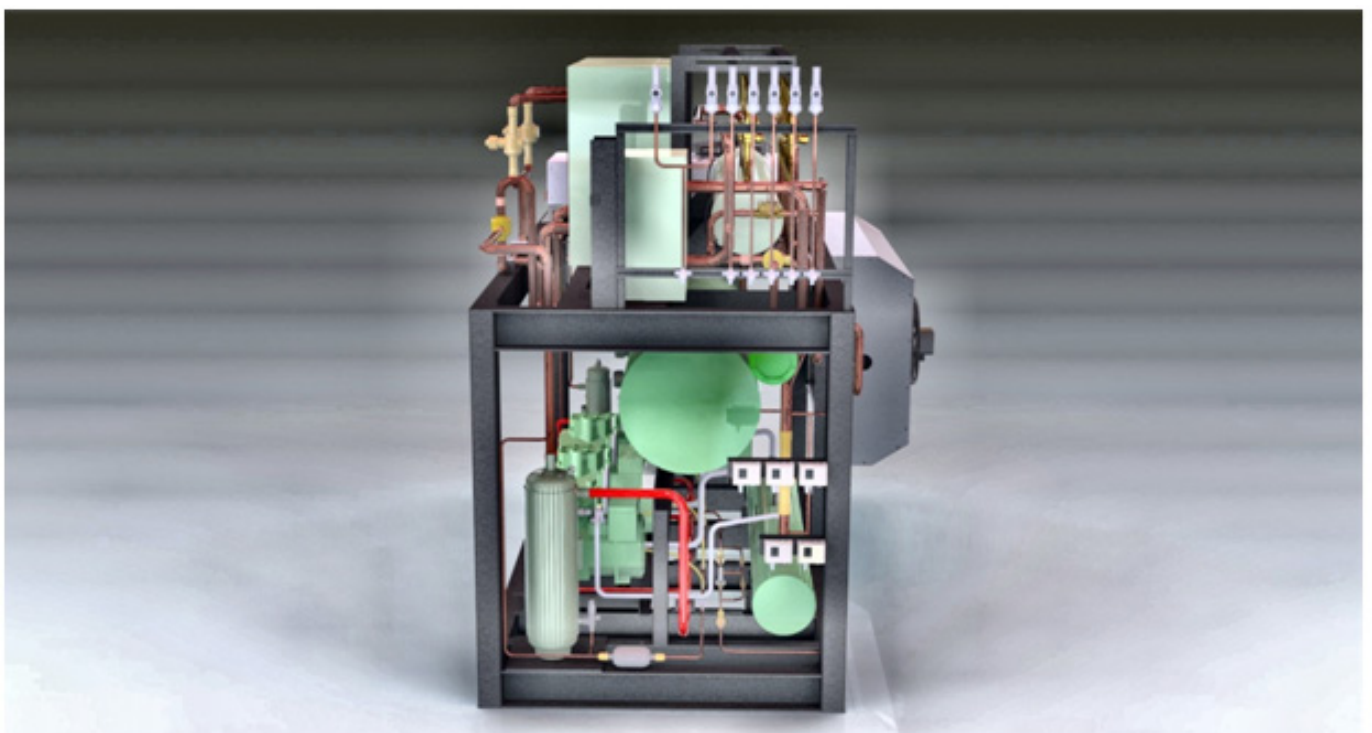
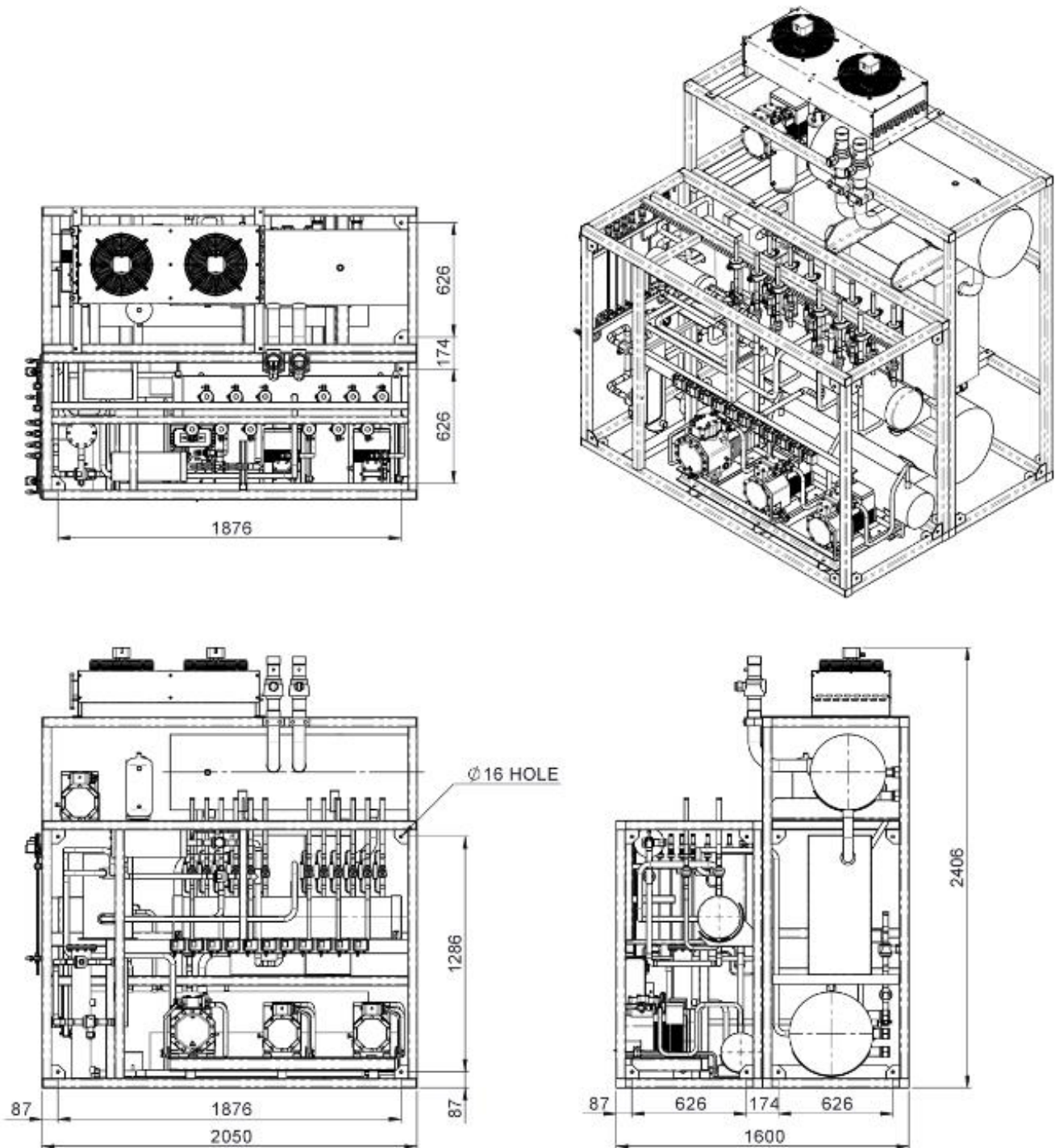
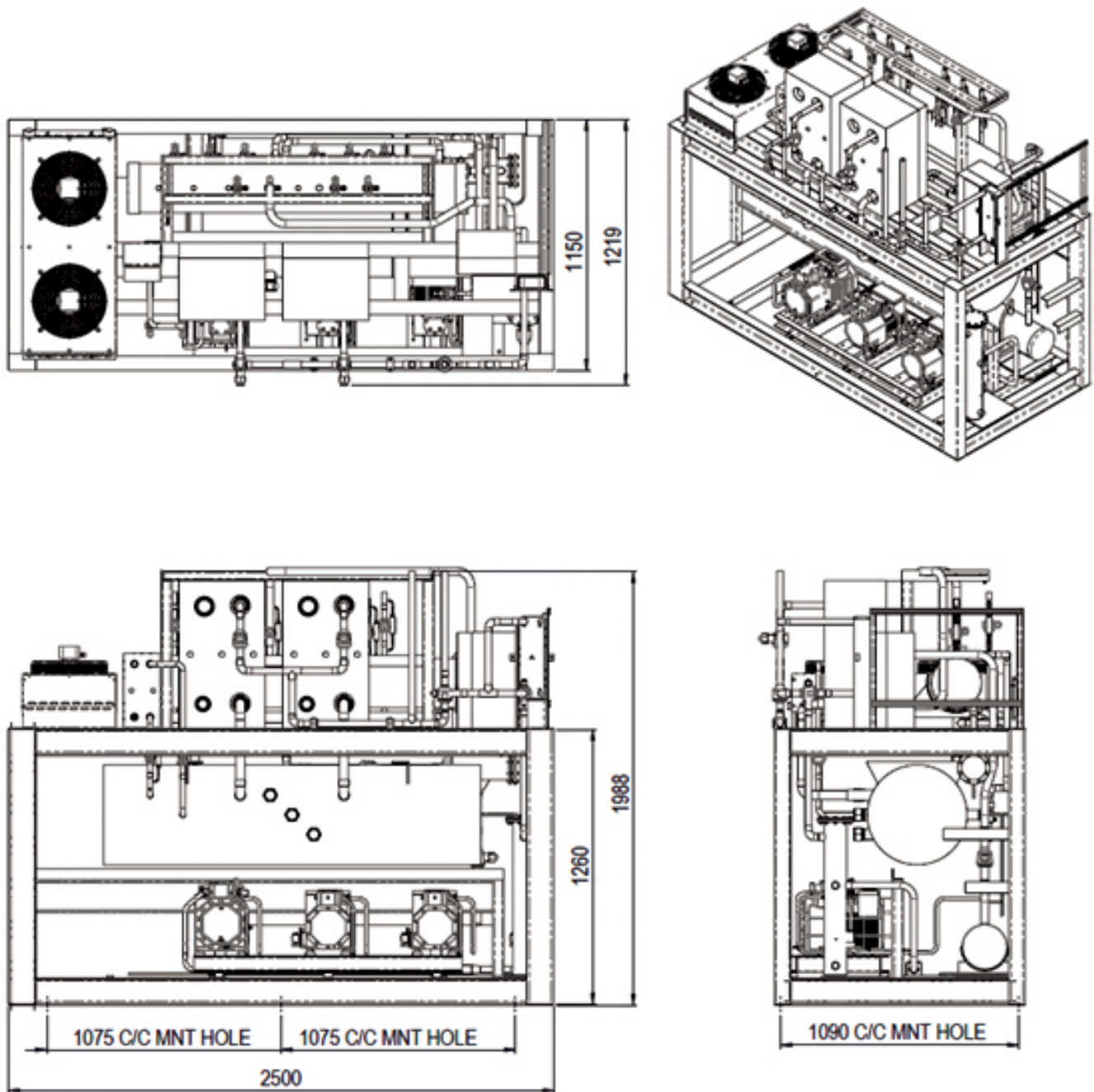


Figure 30 - BITZER 2 Compressor CO<sub>2</sub> DX Hybrid Low Temperature Rack Dimensional drawing



**Note:** Dimensions are subject to change for special [non-standard.] applications.

Figure 31 - BITZER 3 or 4 Compressor CO<sub>2</sub> DX Hybrid Low Temperature Rack Dimensional drawing.

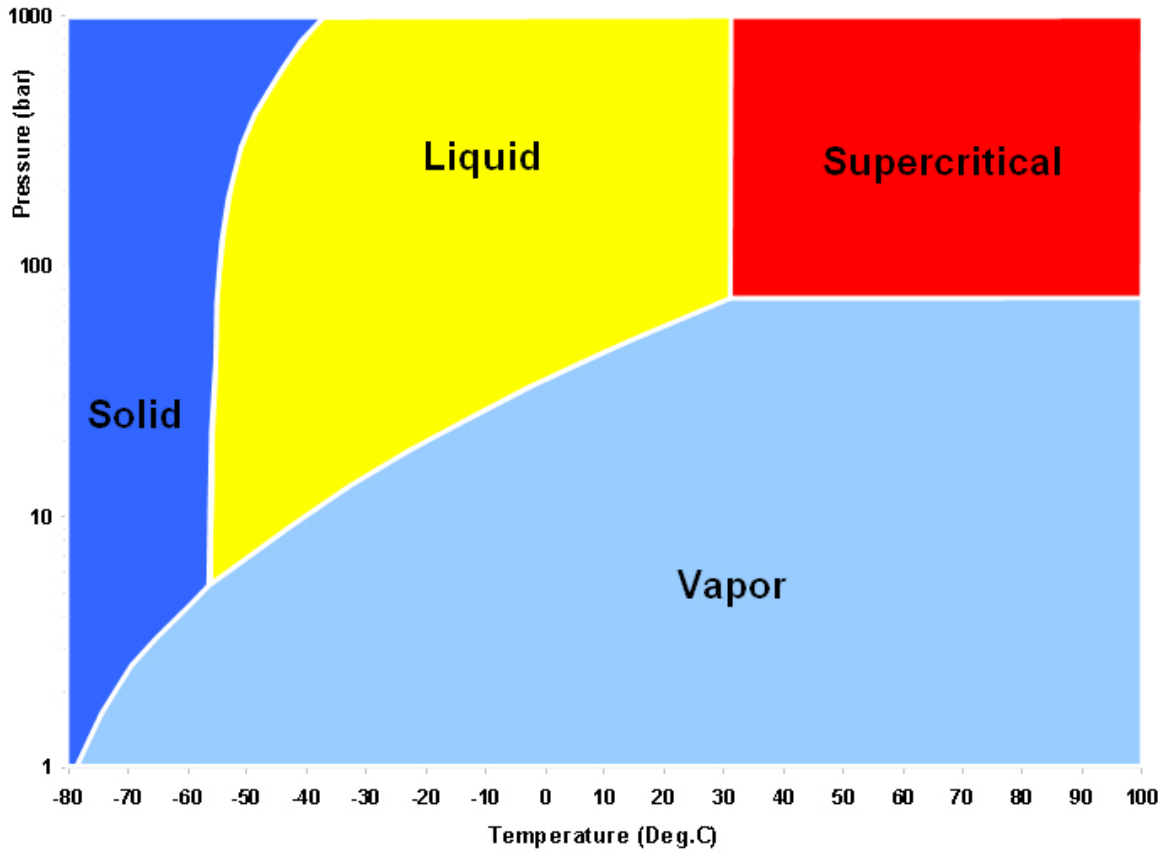


Note: Dimensions are subject to change for special [non-standard.] applications.

#### 14. R744 CO<sub>2</sub> Pressure Temperature Chart

## 15. R744 CO<sub>2</sub> Operating Window.

The R744 CO<sub>2</sub> operating window displays the fact where R744 CO<sub>2</sub> refrigerant must be initially charged as vapour only to reduce the risk of the refrigerant forming internally as DRY ICE.





## 16. R744 CO<sub>2</sub> Material Safety Data Sheet.

### Safety Data Sheet

Version : 1

**Product : R744**

MSDS Nr : 300-00-2008BOC(A)

Date : 13/12/2005

**BOC, UNITED KINGDOM**

#### 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY

- Product name R744
- Chemical formula CO<sub>2</sub>
- Company identification see heading and/or footer

#### 2. COMPOSITION/INFORMATION ON INGREDIENTS

- Substance/Preparation Substance.
- Components/Impurities Contains Carbon dioxide {EINECS No. 204-696-9}
- CAS Nr 124-38-9
- EC Nr (from EINECS) 204-696-9

#### 3. HAZARDS IDENTIFICATION

- Hazards identification Liquified gas
- In high concentrations may cause asphyxiation.

#### 4. FIRST AID MEASURES

- Low concentrations of CO<sub>2</sub> cause increased respiration and headache.
- High concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness.
- Victim may not be aware of asphyxiation.
- Remove victim to uncontaminated area wearing self-contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.
- Skin/eye contact:
  - In case of liquid burn, spray with water for at least 15 minutes. Apply a sterile dressing
  - Immediately flush eyes thoroughly with water for at least 15 minutes
  - Obtain medical assistance
- Ingestion is not considered a potential hazard of exposure.

#### 5. FIRE FIGHTING MEASURES

- Specific hazards:
  - Exposure to fire may cause containers to rupture/explode.
  - Non flammable
  - Hazardous combustion products
  - Non-suitable extinguishing media
  - All known extinguishants can be used
- Specific methods If possible:
  - Stop flow of product.
  - Move away from the container and cool with water from a protected position





## 17. BITZER BSE 60K OIL Material Safety Data Sheet.

### MATERIAL SAFETY DATA SHEET

According to 91/155/EC

Printing date 23.03.2006 Reviewed on 23.03.2006

#### Identification of substance:

- Product details:
- Trade name: BSE60K OIL
- Application of the substance / the preparation: Lubricant
- Manufacturer/Supplier:  
FUCHS EUROPE SCHMIERSTOFFE GMBH EXPORT DIVISION  
Friesenheimer Str. 15  
D-68169 Mannheim  
Tel: ++49 (0)621/3701-0 (Switch Board)  
Fax: ++49 (0)621/3701-570
- Informing department:
  - Product safety department Tel: ++49 (0)621/3701-333
- Emergency information:
  - Tel: ++49 (0)621/3701-333 or ++49 (0)621/3701-0 (Switch Board)

#### 2 Composition/Data on components:

- Chemical characterization
- Description: Mixture of synthetic base oils with additives.
  - Dangerous components: R-phrases
  - Triaryl phosphate 0.1-1 %
  - N; R 50/53
- Additional information
  - For the wording of the listed risk phrases refer to section 16.

#### Hazards identification

- Hazard designation:
  - By handling of mineral oil products and chemical products no particular hazard is known when normal precautions (item 7) and personal protective equipment (item 8) are kept.
- Information pertaining to particular dangers for man and environment
  - This product is water polluting; see item 12.
  - R 52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
- Classification system
  - The classification is in line with current EC lists. It is expanded, however, by information from technical literature and by information furnished by supplier companies.
  - The classification results from the Conventional Method of 1999/45/EC concerning specific data of compounds.

#### First aid measures

- General information:
  - Change clothes and shoes contaminated or soaked by the product.
  - Never put rags contaminated by the product into cloth-pockets.
- After inhalation:
  - Supply fresh air; consult doctor in case of symptoms. (Eventually by inhaling the overheated product)
- After skin contact: The product is not skin irritating.
- After eye contact: Rinse opened eye for several minutes under running water.
- After swallowing: In case of persistent symptoms consult doctor.

#### Fire fighting measures

- Suitable extinguishing agents CO<sub>2</sub>:
  - Extinguishing powder or water jet. Fight larger fires with water jet or alcohol-resistant foam.
  - Use fire fighting measures that suit the environment.
- For safety reasons unsuitable extinguishing agents: Water with a full water jet.
- Protective equipment: In case of fire fighting wear self-containing breathing apparatus

## 17. BITZER BSE 60K Material Safety Data Sheet continued:

### Accidental release measures

- Person-related safety precautions:
  - Particular danger of slipping on leaked/ spilled product.
- Environmental protection measures:
  - Inform respective authorities in case product reaches water or sewage system.
  - Do not allow to enter drainage system, surface or ground water.
  - Prevent from spreading (e.g. by binding or oil barriers).
  - Do not allow to enter the ground/ soil.
- Measures for cleaning/collecting:
  - Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
  - Dispose of the material collected according to regulations.

### Handling and storage

#### Handling

- Information for safe handling:
  - Prevent formation of aerosols.
  - Do not eat, drink or smoke when working with the product.
  - Take usual precautions when handling mineral oil products or chemical products.
- Information about protection against explosions and fires:
  - **Do not heat up Oil to temperatures close to the flash point.**

#### Storage

- Requirements to be met by storerooms and containers:
  - No special requirements.
- Information about storage in one common storage facility: Store away from foodstuffs.
- Further information about storage conditions:
  - Local regulations concerning handling and storage of water polluting products have to be followed.

### Exposure controls and personal protection

- Additional information about design of technical systems:
  - No further data; see item 7.
- Components with critical values that require monitoring at the workplace:
  - The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
- Additional information:
  - The lists that were valid during the compilation were used as basis.
- Personal protective equipment
- General protective and hygienic measures
  - The usual precautionary measures should be adhered to in handling the chemicals and the mineral oil products.
  - Wash hands during breaks and at the end of the work.
  - Avoid close or long term contact with the skin.
  - Use skin protection cream for preventive skin protection.
  - Do not carry cleaning cloths impregnated with the product in trouser pockets.
- Breathing equipment: Not required.
- Protection of hands: Protective gloves and protective skin cream.
- Material of gloves
  - The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.
- Penetration time of glove material
  - The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
- Eye protection: Safety glasses recommended during refilling.
- Body protection: Protective work clothing.



## 17. BITZER BSE 60K Material Safety Data Sheet continued:

### Physical and chemical properties: General Information

- Form: Fluid
- Colour: Light yellow
- Smell: Characteristic
- Value/Range Unit Method
- Change in condition
- Melting point/Melting range: Not determined
- Boiling point/Boiling range: Not applicable or not determined
- Flash point: 286°C ISO 2592
- Decomposition temperature: Not determined
- Self-in flammability: **Product is not self-igniting.**
- Danger of explosion: Product is not explosive.
- Density at 20°C 1.01 g/cm<sup>3</sup> DIN 51 757
- Solubility in / Miscibility with
- Water: Not miscible or difficult to mix
- Viscosity or Consistency-Class:
- Kinematic: at 40°C 55 mm<sup>2</sup>/s DIN 51 562

### Stability and reactivity

- Thermal decomposition / conditions to be avoided:
  - No decomposition if used according to specifications.
- Dangerous reactions No dangerous reactions known
- Dangerous products of decomposition:
  - No dangerous decomposition products known

### Toxicological information

#### Acute toxicity:

- Primary irritant effect:
  - on the skin: No irritant effect known.
  - on the eye: No irritant effect known.
- Sensitization: No sensitizing effect known.
- Additional toxicological information:
  - When used and handled according to specifications, the product does not have any harmful effects according to our actual information.

### Ecological information:

- Behaviour in environmental systems:
- Mobility and bioaccumulation potential: No data available
- Eco-toxic effects:
- Remark: Harmful to fish
- Behaviour in sewage processing plants:
- The product sinks in the sewage water on account of its high specific gravity; eventually it is able to pass the conventional collector for light-density material.
- General notes:
  - German Water Endangering Class 1 (Self-assessment): slightly hazardous for water.
  - Do not allow to reach ground water, water bodies or sewage system.
  - Harmful to aquatic organisms

### Disposal considerations

- Product:
- Recommendation
  - Must not be disposed of together with household garbage. Do not allow product to reach sewage system. When storing used mineral oil products, ensure that the categories for waste oil and mixing instructions are observed.
- Delivery of waste oil only to officially authorized collectors.
- European waste catalogue
- 13 02 08: other engine, gear and lubricating oils
- Uncleaned packaging's:
- Recommendation:
  - Empty contaminated packaging's thoroughly. They can be recycled after thorough and proper cleaning. Small one-way packaging's have to be disposed according to the local regulations. EWC 15 01 99.

## 17. BITZER BSE 60K Material Safety Data Sheet continued:

### Transport information

- Land transport ADR/RID and GGVS/GGVE (cross-border/domestic)
- ADR/RID-GGVS/E Class: -
- Maritime transport IMDG/GGVSea: • IMDG/GGVSea Class: - • Marine pollutant: No
- Air transport ICAO-TI and IATA-DGR:
- ICAO/IATA Class: -
- Transport/Additional information:
  - No dangerous good acc. to dangerous goods/ transport directions.

### Regulatory information.

- Designation according to EU guidelines:
  - Observe the normal safety regulations when handling chemicals or mineral oil products.
  - The product has been classified and labelled in accordance with EC
  - Directives until 2004/73/EC (29. ATP).
- Risk phrases:
  - 52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
- Safety phrases:
  - Avoid release to the environment. Refer to special instructions/safety data sheets.
- National regulations
- German Water Hazard Class:
  - Water Endangering Class 1 (Self-assessment): slightly hazardous for water.

### Other information:

All ingredients are listed in the European Inventories. These data are based on our present knowledge. However, they shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship. This data sheet is a safety data sheet according to 91/155/EU. For products which are not subject to classification according to EU lists this data sheet is made on a voluntary base.

- Relevant R-phrases
  - 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
- Department issuing data specification sheet:
  - FUCHS EUROPE SCHMIERSTOFFE GMBH Export Division
  - Product Safety Department
- Contact:
  - Product Safety Department:
  - Tel: ++49(0)621/3701-333, Mrs. Manuwald
- Validity:
  - With this latest edition of this MSDS all former editions are invalid.



## 18. Risk Assessment Documentation.

<b>Work Activity:</b> Transport, lifting		
<b>Site / Location:</b> Onsite location		

Those at Risk	Y/N	Comments - enter names of general groups
Contractor:	Y	Installation, personnel and Assistants
Other workers:	Y	
General Public	N	

Comments: The package is supplied shrink wrapped on an export treated wooden skid and requires installing in its final position. No-one under the age of 18 will undertake lifting or slinging operations unless directly and closely supervised by a competent person.

HAZARDS
1. Collision of moving crane, hoist, forklift truck or lifting other device with people or plant. 2. Collision of crane boom, hook, block or other moving part with people or plant 3. Collision of suspended load with people or plant 4. Working in windy or rainy weather or when sunshine makes observation difficult 5. Working at night when there is insufficient lighting to observe the full travel of the load 6. Dropping of load due to mechanical failure of load bearing component (crane, sling or shackle) 7. Dropping of load due to incorrect slinging method or use of equipment or overload of crane or sling 8. Trapped fingers or toes 9. Cuts and abrasions whilst handling chains or sling

Control Measures (existing or planned)	
Control	Details
PPE:	1. Steel toecap boots 2. Overalls/protective clothing 3. Safety helmet 4. Leather gloves for handling chains or slings 5. Safety harness (if appropriate)
Equipment:	1. Forklift 2. Slings, hooks (fitted with safety catches), plate clamps, eyebolts and shackles 3. Crane or hoist (mobile cranes must be fitted with overload warning devices)
Information, Instruction and Training:	1. Observe local standards and guidelines relating to lifting operations and lifting equipment and safe use of cranes 2. Insure that all lifting equipment including forklifts are properly maintained 3. Only qualified personnel should lift or install package 4. No-one under the age of 18 will undertake lifting or slinging operations unless directly and closely supervised by a competent person 5. Any good Boson or Rigger's manual with a section on rigging practices 6. Maintenance checklist of slings and lifting equipment 7. Weights of items slung and lifted should be known before lift is undertaken 8. Only those trained in slinging will carry out these operations 9. Damaged slings of lifting equipment must be discarded immediately and cut or otherwise rendered unuseable 10. For large and unusually shaped loads or loads with not fixed lifting points are provided, a professional rigger should be subcontracted in addition to crane operator 11. The safe working load must be clearly marked on all lifting equipment and tackle. Check before use. 12. A competent person must plan non-routine lifts 13. Ropes, chains or slings should be shortened in a safe manne 14. Lifting tackle will be returned to appropriate storage after use 15. Extreme care should be taken not to trap fingers when loads are being positioned
Control	Details
Supervision:	An experienced person who has been trained in slinging will attach the slings or direct the rigger to the appropriate lifting points. No fixed lifting points are provided, so a competent rigging sub-contractor should be employed. The crane driver will not lead the lift. Forklift drivers should possess relevant licences
Environment:	Lifting and slinging takes place under all conditions and weather - Important considerations are that the load is balanced and that tag lines are used to steady and guide the load. Very windy conditions may prohibit the lift.
Procedures, documents etc:	1. The load should be slung from correctly attached shackles - the most common failure is that of an eyebolt pulled at an incorrect angle 2. The load should be lifted a few inches and checked that it is stable before the full lift is attempted 3. When lifting operations are su-contracted to specialist, the contractor should ensure that the crane was thoroughly examined within the last 12 months, that thie accessories were thoroughly examined within the last 6 months and that both the crane driver and banks man are certified competent. 4. Observe the safety standards and other national safety regulations 5. Refer to relevant BITZER documentation
Communications:	1. Lift should be supervised by suitably trained or qualified persons, radios or other suitable communication devices should be used
Emergency action/procedures:	1. Observe the safety standards and other national safety regulations 2. Persons trained in the use of first aid should be present 3. Call emergency services
Access:	1. Access should be restricted to the area where lift is taking place, issue appropriate signage 2. Access to the area beneath the crane radius over which a load will pass should be prohibited to prevent a load striking a person. Access around the crane will be controlled to prevent the crane trapping persons.

## 18. Risk Assessment Documentation.

Probability of Occurrence		Remote = 1	Possible = 2	Frequent = 3			
Hazard Severity		Minor = 1	Serious (Hospital) = 2	Major (3 days or more) = 3			
<b>Probability of Occurrence x Hazard Severity = Risk Rating (RR)</b>		<b>Probability</b>			<b>Severity</b>		<b>RR</b>
<b>Identified Hazards (base scores on existing or planned control measures)</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>2</b>	
1. Collision with moving plant		1				2	2
2. Collision with moving machine parts		1				2	2
3. Collision with moving materials		1				2	2
4. Weather conditions		1			1		1
5. Insufficient lighting			2		1		2
6. Dropping loads due to mechanical failure		1				3	3
7. Dropping load due to misapplication of lifting equipment			2			2	4
8. Trapped fingers or toes		2	3	1			2
9. Cuts or abrasions					1		1
<b>Note:</b>	Moderate Scores: (1 to 5): Substantial: Intolerable:						
	Thought should be given to reducing risk, but the cost and time Requirements of prevention should be carefully considered and limited Work should not be started until the risk has been reduced, for work (6 to 7) in progress, urgent action is required. Considerable resources may have to be allocated. If unlimited resources cannot reduce risk, work will be prohibited (8 to 9)						
Is risk adequately controlled using the above control measures <b>Y / N</b>				<b>Y</b>	If "No" state further action required		
State further action required:							

**Note:** This risk assessment is only valid when all control measures are in place before the work or activity commences. If the nature of the work changes or there is a dangerous occurrence.





## 18. Risk Assessment Documentation.

<b>Work Activity:</b> Pressure Testing & Evacuating	
<b>Site / Location:</b>	
Onsite location	

Those at Risk	Y/N	Comments - enter names of general groups
Contractor:	Y	Installation, Personnel and Assistants
Other workers:	Y	
General Public	N	
Comments: The package is delivered with a holding charge of dry nitrogen, which requires releasing before additional field pipework is connected. Care should be taken during pressure testing the entire system and during the commissioning of the package.		
<b>HAZARDS</b>		

<b>The following hazards have been identified:</b>	
<ol style="list-style-type: none"> <li>1. Risk of explosion</li> <li>2. Risk of over pressure</li> <li>3. Environmental pollution</li> </ol>	
<b>Control Measures (existing or planned)</b>	
<b>Control</b>	<b>Details</b>
PPE:	<ol style="list-style-type: none"> <li>1. Gloves</li> <li>2. Safety goggles</li> <li>3. Steel toe cap boots</li> </ol>
Equipment:	<ol style="list-style-type: none"> <li>1. General tools</li> <li>2. Calibrated gauges and test equipment</li> </ol>
Information, Instruction and Training:	<ol style="list-style-type: none"> <li>1. Only use dry nitrogen for pressure testing, never use Oxygen or other industrial gases as this leads to an explosion</li> <li>2. Never add refrigerant to the test gas; environmental pollution is possible</li> <li>3. Refer to relevant BITZER documentation</li> <li>4. Only use calibrated gauges and equipment, use serviced regulators to control the flow of nitrogen</li> <li>5. Continuously observe the flow and pressure of nitrogen</li> <li>6. Only qualified personnel should install and commission the package</li> </ol>
<b>Control</b>	<b>Details</b>
Supervision:	<ol style="list-style-type: none"> <li>1. Work should be carried out only by qualified persons</li> <li>2. Observe National Safety Regulations</li> </ol>
Environment:	<ol style="list-style-type: none"> <li>1. Ensure adequate levels of ventilation</li> <li>2. Check emergency exits</li> </ol>
Procedures, documents etc:	<ol style="list-style-type: none"> <li>1. Observe the Safety Standards and National Safety Regulations</li> <li>2. Refer to relevant BITZER documentation</li> <li>3. AS1667</li> </ol>
Communications:	<ol style="list-style-type: none"> <li>1. Comply with site rules permits may be required</li> <li>2. Familiarise yourself with plant site emergency plan</li> </ol>
Emergency action/procedures:	<b>In case of leak:</b> <ol style="list-style-type: none"> <li>1. Isolate leak (if possible)</li> <li>2. If isolation is not possible, evacuate area and follow the site emergency plan</li> <li>3. Treatment to injuries should be in accordance with the product data sheet</li> </ol>
Access:	<ol style="list-style-type: none"> <li>1. Access should be restricted to the area where work is taking place</li> </ol>

## 18. Risk Assessment Documentation.

### Risk Evaluation of Identified Hazards

Probability of Occurrence		Remote = 1		Possible = 2		Frequent = 3	
Hazard Severity		Minor = 1		Serious (Hospital) = 2		Major (3 days or more) = 3	
Probability of Occurrence x Hazard Severity = Risk Rating (RR)				Probability			Severity
Identified Hazards (base scores on existing or planned control measures)				1	2	3	RR
1. Risk of explosion				1			3
2. Risk of over pressure				2			2
3. Environmental pollution				1			1
<b>Note:</b>	Moderate Scores: (1 to 5): Substantial: Intolerable:	Thought should be given to reducing risk, but the cost and time Requirements of prevention should be carefully considered and limited Work should not be started until the risk has been reduced, for work (6 to 7) in progress, urgent action is required. Considerable resources may have to be allocated. If unlimited resources cannot reduce risk, work will be prohibited (8 to 9)					
Is risk adequately controlled using the above control measures Y / N				Y	If "No" state further action required		
State further action required:							

**Note:** This risk assessment is only valid when all control measures are in place before the work or activity commences. If the nature of the work changes or there is a dangerous occurrence.



## 18. Risk Assessment Documentation.

Work Activity: <b>Charging/Decanting Refrigerant</b>			
Site / Location:  <b>On site location</b>			
<b>Those at Risk:</b>	<b>Y / N</b>	<b>Comments - enter names or general groups</b>	
Contractors:	Y	Installation, Personnel and Assistants	
Other Workers:	Y	Sub-contractors, site maintenance personnel	
General Public	N		
<b>Comments:</b> When charging a system, when decanting a system, it is also very easy to overfill a recovery cylinder. An <b>overfilled</b> refrigerant recovery cylinder represents a serious explosion hazard. It is essential that proper charging and recovery procedures be observed to prevent serious incidents involving injury or accidental emission of refrigerant.			
<b>HAZARDS</b>			

<b>The following hazards have been identified:</b> 1. Explosion 2. Asphyxiation 3. Refrigerant liquid burns 4. Manual handling injury when moving cylinders or plant	
Control Measures (existing or planned)	
Control	Details
PPE:	1. Safety boots with a heel, good grip and steel to cap 2. Overalls/protective clothing 3. Safety goggles 4. Neoprene impervious gloves 5. Hard hat
Equipment:	1. Refrigerant recovery pump 2. Scales (for recovery) 3. Suitable charging/transfer lines 4. Properly identified refrigerant recovery cylinders 5. Log book for recording amount charged, decanted or transferred
Information, Instruction and Training:	1. Wear impervious gloves to prevent refrigerant contacting the hands 2. Eye protection must be worn when opening any refrigeration system. As a minimum goggles are required. 3. Only persons experienced in handling refrigerations and with relevant licences will charge, decant refrigerant. They may have an apprentice or assistant helping them or observing the operation. 4. Continuously and accurately weigh recovery cylinders during decanting 5. Continuously supervise charging, decanting or transferring operations 6. Secure cylinders from falling over 7. Do not trap liquid refrigerant between valves 8. Use mechanical handling equipment or follow good manual handling techniques 9. Warning signs to be erected, warning of hazards 10. Transfer lines to be made safe by marking with bunting to stop accidental collision
Control	Details
Supervision:	1. Contractors should ensure that all persons are properly trained in handling refrigerants and have current dated handling licence
Environment:	1. Ensure adequate levels of ventilation 2. Check emergency exits
Procedures, documents etc:	1. When charging liquid refrigerant, disconnect the hoses slowly in case liquid remains in the hose (frost on hose may indicate that liquid is still present). 2. Keep an accurate record of the amount of refrigerant added, decanted or transferred
Communications:	1. Comply with site rules permits may be required 2. Familiarise yourself with plant site emergency plan
Emergency action/procedures:	<b>In case of leak:</b> 1. Isolate leak (if possible) 2. If isolation is not possible, evacuate area and follow the site emergency plan 3. Treatment to injuries should be in accordance with the product data sheet
Access:	1. Access should be restricted to the area where work is taking place
Environmental:	1. Disposal of waste refrigerants covered by various Environmental Protection Acts, refer to local, observe the Safety Standards and other National Safety Regulations

## 18. Risk Assessment Documentation.

### Risk Evaluation of Identified Hazards

Probability of Occurrence	Remote = 1	Possible = 2		Frequent = 3				
Hazard Severity	Minor = 1	Serious (Hospital) = 2		Major (3 days or more) I = 3				
Probability of Occurrence x Hazard Severity = Risk Rating (RR)		Probability			Severity		RR	
Identified Hazards (base scores on existing or planned control measures)		1	2	3	1	2		3
1. Explosion		1					3	4
2. Asphyxiation		1					3	4
3. Refrigerant liquid burns			1			2		4
4. Manual handling injury when moving cylinders or plants		1				2		4

<b>Note:</b>	Moderate Scores: (1 to 5):	Thought should be given to reducing risk, but the cost and time Requirements of prevention should be carefully considered and limited
	Substantial:	Work should not be started until the risk has been reduced, for work (6 to 7) in progress, urgent action is required.
	Intolerable:	Considerable resources may have to be allocated. If unlimited resources cannot reduce risk, work will be prohibited (8 to 9)
Is risk adequately controlled using the above control measures <b>Y / N</b>		<b>Y</b> If "No" state further action required
State further action required:		

**Note:** This risk assessment is only valid when all control measures are in place before the work or activity commences. If the nature of the work changes or there is a dangerous occurrence.



## 18. Risk Assessment Documentation.

Work Activity: <b>Electrical Connections</b>		
Site / Location:  <b>On site location</b>		
<b>Those at Risk:</b>	<b>Y / N</b>	<b>Comments - enter names or general groups</b>
End User Employees	Y	Installation, Service and Maintenance Personnel and Assistants
Other Workers:	N	
General Public	N	
<b>Comments:</b> The package is supplied with no wiring, contractors need to wire mains power for compressor and relevant control circuits. Work should only be carried by qualified persons.		
<b>HAZARDS</b>		

<b>The following hazards have been identified:</b> 1. Electric shock incorrect wiring 2. Electric shock from earth leakage	
<b>Control Measures (existing or planned)</b>	
<b>Control</b>	<b>Details</b>
PPE:	1. N/A
Equipment:	1. General hand tools (insulated) 2. Electrical test equipment eg. Clamp amp meter, multi-meter, test lamp etc. Insulated fused and with calibration. 3. Warning notices
Information, Instruction and Training:	1. Electrical installation should be carried out in accordance with wiring diagram in the compressor terminal box 2. Observe the Safety Standards and other National Safety Regulations 3. Compressor housing must be grounded or connected to an equipotential bond 4. Refer to relevant BITZER documentation
<b>Control</b>	<b>Details</b>
Supervision:	1. Work should only be carried out by qualified persons 2. Observe National Safety Regulations
Environment:	1. Observe National Safety Regulations in case of emergency
Procedures, documents etc:	1. Observe the Safety Standards and other National Safety Regulations 2. Refer to relevant BITZER documentation
Communications:	1. If in doubt contact your local BITZER office
Emergency action/procedures:	1. Switch off and isolate supply 2. Remove injured person(s) from danger area (if without risk) 3. Call emergency services
Access:	1. The normal site rules restrict access to the panel room to authorised maintenance personnel who are all familiar with electrical safety

## 18. Risk Assessment Documentation.

### Risk Evaluation of Identified Hazards

Probability of Occurrence	Remote = 1	Possible = 2	Frequent = 3
Hazard Severity	Minor = 1	Serious (Hospital) = 2	Major (3 days or more) I = 3
Probability of Occurrence x Hazard Severity = Risk Rating (RR)	Probability		
Identified Hazards (base scores on existing or planned control measures)	1	2	3
	1	2	3
1. Electric shock, incorrect wiring	1		3
2. Electric shock from earth leakage	1		3

<b>Note:</b>	Moderate Scores: (1 to 5): Substantial: Intolerable:	Thought should be given to reducing risk, but the cost and time Requirements of prevention should be carefully considered and limited Work should not be started until the risk has been reduced, for work (6 to 7) in progress, urgent action is required. Considerable resources may have to be allocated. If unlimited resources cannot reduce risk, work will be prohibited (8 to 9)
Is risk adequately controlled using the above control measures <b>Y / N</b>		<b>Y</b> If "No" state further action required
State further action required:		

**Note:** This risk assessment is only valid when all control measures are in place before the work or activity commences. If the nature of the work changes or there is a dangerous occurrence.





## 18. Risk Assessment Documentation.

Work Activity: <b>Electrical fault finding/testing within the packaged unit</b> <b>During commissioning, service and maintenance</b>		
Site / Location:  <b>On site location</b>		
<b>Those at Risk:</b>	<b>Y / N</b>	<b>Comments - enter names or general groups</b>
Contractors:	Y	Service and Maintenance Contractors and Assistants
Other Workers:	Y	On-site maintenance personnel
General Public	N	
<b>Comments:</b> All circuits to be worked on will be treated as live until verified dead. There are no exceptions to this requirement; experience of employees is irrelevant.		
<b>HAZARDS</b>		
<p>Because of the complexity of the refrigeration package control circuits, it will occasionally be necessary to carry out "live" testing/fault finding. This assessment addresses the hazards associated with such work. "Live" testing/fault finding is to be carried out by a trained, competent, authorised person.</p> <p>In general, each plant contains control circuitry at 240 Volts and power circuits at 415 Volts 3 Phase</p> <p><b>The following hazards have been identified:</b></p> <ol style="list-style-type: none"> <li>1. Electric shock from power circuitry</li> <li>2. Electric shock from 240 Volt control circuitry</li> <li>3. Eye injury (from an electric arc)</li> <li>4. Burn injury</li> <li>5. Injury to third party (Maintenance Personnel)</li> </ol>		
<b>Control Measures (existing or planned)</b>		
<b>Control</b>	<b>Details</b>	
PPE:	<b>For Live Testing:</b> <ol style="list-style-type: none"> <li>1. Rubber soled shoes or boots</li> <li>2. Rubber mats</li> <li>3. Safety glasses</li> <li>4. Suitable work wear overalls</li> </ol> <b>For work on dead systems:</b> <ol style="list-style-type: none"> <li>1. Padlock (for lock-off isolator)</li> </ol>	
Equipment:	<ol style="list-style-type: none"> <li>1. General hand tools (insulated)</li> <li>2. Electrical test equipment eg. Clamp amp meter, multi-meter, test lamp etc. Insulated fused and with calibration.</li> <li>3. Warning notices</li> <li>4. Suitable means of cordoning-off the work area eg. red and white bunting</li> </ol>	
Information, Instruction and Training:	<ol style="list-style-type: none"> <li>1. Isolate (by removing fuses) power circuits within a panel before fault finding</li> <li>2. Prove your test instrument prior to and immediately after testing for "dead"</li> <li>3. Test for "dead" power circuits with exposed conductors</li> <li>4. Fault find power circuits in the "dead" condition</li> <li>5. The 240 Volt control circuit may be kept live for fault finding purposes providing that there is no reasonable way of doing the work "dead" and that all control measures are followed</li> <li>6. When live testing ensure that a current wiring diagram is available and followed</li> <li>7. Familiarise yourself with all safety and operating controls such as pressure switches, oil differential switches, motor starters etc.</li> <li>8. Isolate or discharge power factor correction capacitors before primary circuit work (if installed)</li> </ol>	
<b>Control</b>	<b>Details</b>	
Supervision:	<ol style="list-style-type: none"> <li>1. Two person team required whilst live testing is being carried out; keep other persons away from the work area</li> </ol>	
Environment:	<ol style="list-style-type: none"> <li>1. Maintain a 1m clear space around the work area</li> <li>2. Rubber mats should be placed around package, ensure that eses do not pose a trip hazard</li> </ol>	
Procedures, documents etc:	<ol style="list-style-type: none"> <li>1. Follow site safety rules</li> <li>2. Lock individual panel doors</li> </ol>	
Communications:	<ol style="list-style-type: none"> <li>1. Inform the site manager when isolating panels as this may mean safety circuits are being isolated. Inform second person (if applicable) of emergency actions.</li> </ol>	
Emergency action/procedures:	<ol style="list-style-type: none"> <li>1. Switch off and isolate supply</li> <li>2. Remove injured person(s) from danger area (if without risk)</li> <li>3. Call emergency services</li> </ol>	
Access:	<ol style="list-style-type: none"> <li>1. The normal site rules restrict access to the panel room to authorised maintenance personnel who are all familiar with electrical safety</li> </ol>	

## 18. Risk Assessment Documentation.

### Risk Evaluation of Identified Hazards

Probability of Occurrence	Remote = 1	Possible = 2		Frequent = 3					
Hazard Severity	Minor = 1	Serious (Hospital) = 2		Major (3 days or more) I = 3					
Probability of Occurrence x Hazard Severity = Risk Rating (RR)			Probability		Severity			RR	
Identified Hazards (base scores on existing or planned control measures)			1	2	3	1	2		3
1. Electric shock from power circuitry				2				3	5
2. Electric shock from 110 Volt control circuit				2			2		4
3. Eye injury (from electric arc)			1				2		3
4. Burn injury			1				2		3
5. Injury to third party (Maintenance Personnel)			1				2		3

<b>Note:</b>	Moderate Scores: (1 to 5): Substantial: Intolerable:	Thought should be given to reducing risk, but the cost and time Requirements of prevention should be carefully considered and limited Work should not be started until the risk has been reduced, for work (6 to 7) in progress, urgent action is required. Considerable resources may have to be allocated. If unlimited resources cannot reduce risk, work will be prohibited (8 to 9)
Is risk adequately controlled using the above control measures Y / N		Y
State further action required:		If "No" state further action required

**Note:** This risk assessment is only valid when all control measures are in place before the work or activity commences. If the nature of the work changes or there is a dangerous occurrence.

## 19. MANUFACTURER

- Our products are manufactured in compliance with applicable international standards and regulations. If you have any questions about how to use our products or if you are planning special applications please contact:

BITZER Australia Pty Ltd  
134-136 Dunheved Circuit  
St Marys NSW 2760  
Tel.: +61 (0)2 8801 9300  
Fax: +61 (0)2 9673 4698

Please contact us via email and visit our website:  
info@bitzer.com.au  
www.bitzeravp.com.au

## 20. SERVICE ADDRESS

- For local support please refer to our website [www.bitzeravp.com.au](http://www.bitzeravp.com.au) for a list of our nearest branch office.



In the interest of continuous improvement BITZER reserves the right to change the specifications or design of any of its products without notice. The BITZER Symbol, Name BITZER and model numbers are registered trade marks. All products manufactured are pending design and specification registration and must not be copied or duplicated in any way.

Please note: The ISO Certification applies to New South Wales and Victoria branches only.

<b>NSW</b>	<b>Victoria</b>	<b>SA</b>	<b>WA</b>	<b>QLD</b>	<b>NZ</b>
tel +61 (2) 8801 9300 fax +61 (2) 9673 4698	tel +61 (3) 8326 8200 fax +61 (3) 9310 2520	tel +61 (8) 8345 6110 fax +61 (8) 8268 4555	tel +61 (8) 6350 6297 fax +61 (8) 9359 2077	tel +61 (7) 3725 1360 fax +61 (7) 3274 3621	tel +64 9 415 2030